

September 28, 2017

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RE: Butte Priority Soils Operable Unit (BPSOU) Draft Final Revised Scrap H Road Work Plan

Gentlemen:

I am writing you on behalf of Atlantic Richfield Company to submit the Draft Final Revised Scrap H Road Work Plan, Revised for your review and approval.

Hard copies are being provided to the EPA and DEQ; all others will receive via email.

If you have questions or concerns, please do not hesitate to call me at (406) 723-1826.

Sincerely,

(b) (6)

Loren Burmeister
Operations Project Manager
Remediation Management Services Company
An affiliate of **Atlantic Richfield Company**

Cc: Patricia Gallery / Atlantic Richfield - email
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Robert Bylsma / UP - email
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Bill Jackson / UP - email
Gary Honeyman / UP - email
Leo Berry / BNSF - email
Robert Lowry / BNSF – email
John Ashworth / BNSF - email
Brooke Kuhl / BNSF - email
Lauren Knickrehm / Kennedy/Jenks - email
Matthew Mavrinac / RARUS - email
Leean Greenwald / RARUS - email
Becky Summerville / Inland - email
Jon Sesso / BSB - email
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Eric Hassler / BSB - email
Dave Schultz / BSB - email

Pat Riordan / BSB - email
Molly Maffei / BSB - email
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Josh Vincent / WET - email
Don Booth / AR Consultant - email
Craig Deeney / TREC - email
Scott Bradshaw / TREC - email
Brad Archibald / Pioneer - email
Pat Sampson / Pioneer - email
Dave Griffis / Pioneer - email
Mike Borduin / Pioneer - email
Josh Bryson / Pioneer - email
Leesla Jonart / Pioneer - email
CTEC of Butte - email
Montana Tech Library - hard copy

File: MiningSharePoint@bp.com - email
BPSOU SharePoint - upload

**SILVER BOW CREEK/BUTTE AREA NPL SITE
BUTTE PRIORITY SOILS OPERABLE UNIT**

Draft Final Revised

Scrap H Road Work Plan

Atlantic Richfield Company

September 28, 2017

Response to Agency Comments to the Draft Final Scrap H Road Work Plan
Received on September 5, 2017
Prepared for Atlantic Richfield Company
By Pioneer Technical Services, Inc.
Dated September 14, 2017

General Comments:

1. Agency Comment:

Please rename this document to "Draft Final Scrap H Road Work Plan".

Atlantic Richfield Response:

Document has been renamed Draft Final Revised Scrap H Road Work Plan as noted.

2. Agency Comment:

Overall, the work proposed to regrade and cap materials, and rehabilitate the roadway appear adequate to provide a safe and effective haul route and provide adequate protection to human health from elevated COCs in soils. Some comments remain below to address upgradient and downgradient areas to Waste Dump #25.

Atlantic Richfield Response:

Comment noted.

3. Agency Comment:

Attached XRF screening data table references non-residential screening levels. Based on the location of this site adjacent to residential properties, residential screening levels should be considered in accordance with the RMAP. Please update the screening levels as appropriate and/or provide RMAP data that represents the areas assessed and/or remediated. Our concern is that there are high levels of lead and the work area and upgradient and downgradient areas, appear to fall within 100 feet of residential properties.

Atlantic Richfield Response:

The adjacent residential property was sampled and remediated under the RMAP; if additional response actions are needed on the residential property, those actions should be performed under the RMAP. This Work Plan only pertains to non-residential areas.

4. Agency Comment:

Extensive surface rilling is present at the Scrap H Road site. Screening results for arsenic and lead are far in excess of residential screening levels directly above a residential area. Transport of soils containing elevated COCs beyond the designated regrade and cap area is highly likely. Therefore, reclamation of these downgradient areas needs to be considered. Further evaluations are necessary to determine the extent of contamination and assess the need for reclamation beyond the defined source area boundary for Waste Dump #25.

Atlantic Richfield Response:

See response to Comment 3.

5. Agency Comment:

Since mobilization of a contractor and equipment to the area is proposed, reclamation of other adjacent source areas should be considered. These additional source areas include 1702, 1702N, 1703, and 1703E that are upgradient and adjacent to Waste Dump #25.

Atlantic Richfield Response:

Comment noted. These sites require further evaluation to determine whether reclamation is required. This evaluation will be performed under a future effort.

Specific Comments:

1. Agency Comment:

Sheet 1 of 8 plan view:

- a. The grading contours and existing contours are not labeled. Labels are needed to confirm grades and show correct tie-in to existing ground outside of the work area.*
- b. New grading layer shows the triangles from the ACAD model in addition to the grade contours. This clutter makes the entire drawing difficult to read, including the existing contours, stationing, etc. These triangles should be turned off for a final drawing to be used for construction.*
- c. Stationing along the road is provided, however, section lines that match the sections shown on sheets 3 to 5 are not indicated. Please add section lines to reference the cut/fill sections.*
- d. Callout 'Rock Section, See Sheet 8 of 8'. It is not clear where the rock section(s) is supposed to go based on where the arrows are pointing, and all the triangle clutter on the sheet. Please show clearly where the rock sections (channel) shall go on the plan view sheet. Also, clarify if this sheet should reference the 'rock section (south side)' detail on sheet 7?*
- e. Callout 'Riprap inlet, see detail 1, 7 of 8' is for the culvert inlet, but is referencing the detail for the riprap apron at the culvert outlet. Please clarify.*

Atlantic Richfield Response:

For item a. labeled contours and item b., triangles have been turned off. For item c. section lines have been added. For item d., the triangles have been removed and the rock section detailed on sheet 7 of 8 is for both the north and south side. For item e., the detail has been clarified.

2. Agency Comment:

Sheet 8 of 8 culvert profile:

- a. The profile shows an 18-inch riprap layer over the pipe on the new graded surface. Shouldn't the surface be an 18-inch soil cover per specifications? Please clarify.*

Atlantic Richfield Response:

The riprap section is aligned with the cutouts on the road berm to prevent slope erosion during storm events. The berm directs storm water to a single outlet to prevent the area rilling on the south slope.

SILVER BOW CREEK/BUTTE AREA NPL SITE BUTTE PRIORITY SOILS OPERABLE UNIT

Draft Final Revised

Scrap H Road Work Plan

Prepared for:

Atlantic Richfield Company
317 Anaconda Road
Butte, Montana 59701

Prepared by:

Pioneer Technical Services, Inc.
P.O. Box 3445
Butte, Montana 59702

September 28, 2017

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LIST OF APPENDICES

Note: Appendix C and D are provided electronically.

Appendix A Soil Testing
Appendix B Construction Drawings
Appendix C Technical Specifications
Appendix D Design Report

REVISION SUMMARY

Revision No.	Author	Version	Description	Date
Rev 0	Leonard J. Dueck, PE	Draft	Submitted for Atlantic Richfield Company Review	8-4-2017
Rev 1	Leonard J. Dueck, PE	Draft Final	Submitted for Agency Review	8-24-2017
Rev 2	Leonard J. Dueck, PE	Draft Final Revised	Submitted for Agency Review	9-28-2017

1.0 INTRODUCTION AND PURPOSE

A wooden flume (culvert) located under Scrap H Road approximately 550 feet east of its intersection with N. Main Street in Walkerville, Montana, collapsed. Scrap H Road is a primary truck route into the Butte-Silver Bow (BSB) Mine Waste Repository. The collapsed infrastructure blocked storm flows behind the raised road section. While these [blocked] storm flows have no direct impact on Silver Bow Creek due to runoff directed to the Alice Pit, the collapse does affect adjoining Superfund storm water infrastructure. As such, the Scrap H Road Culvert Project (Project) will initiate remediation efforts to mitigate storm flow blockages, flatten roadside slopes, widen a narrow road section, cap metals-impacted areas, and vegetate barren areas. The project design will control storm water flows and possible erosion in reclaimed areas using various methods such as site grading, cap and cover, revegetation, rock sections, rock outfall, and culvert installation. This Third Cycle Best Management Practice (BMP) Work Plan describes the remedial actions necessary to address the storm water issues and unreclaimed source areas in accordance with the U.S. Environmental Protection Agency (EPA) Butte Priority Soils Operable Unit (BPSOU) Record of Decision (ROD) (EPA, 2006) and Section 3.2 of the BPSOU Unilateral Administrative Order (UAO) (EPA, 2011).

On May 31, 2017, BSB collected soil samples from the steep south slope to determine whether additional reclamation of the slopes was required. Samplers collected 5-point composites and testing the samples using an X-ray fluorescence (XRF) instrument. Each composite sample was tested 3 different times to determine an average. Samples were collected from the 0-6 inch depth and the 6-12 inch depth. The sampling location map and table of results are included in Appendix A.

The work is to be completed by an independent contractor retained by Atlantic Richfield Company and completed in a single phase with individual tasks scheduled to prevent work flow conflicts. If roadway shutdowns are necessary they will be during weekends to mitigate truck traffic to the Mine Waste Repository. Design and reclamation activities will be completed in accordance with EPA-required Applicable or Relevant and Appropriate Requirements (ARARs). Once remedial actions are complete, long-term operations and maintenance (O&M) will be completed in accordance with the Butte Reclamation Evaluation System (EPA, 2006).

Appendix A contains the Soil Sampling results, Appendix B contains the Construction Drawings, Appendix C contains the Technical Specifications, and Appendix D contains the design details.

2.0 BACKGROUND

Scrap H Road is a primary truck route into the BSB Mine Waste Repository. The current road section narrows over a collapsed wooden flume, which creates a bottleneck when truck traffic meets at the narrow section. The collapsed flume causes storm water to back up against the elevated road section. The south slope is steep and barren with multiple erosion areas where storm flows drain off of the road section. As part of this Project, the road section will be widened to BSB gravel road specifications and moved north to flatten the existing south slope to a 3:1 horizontal:vertical grade or less and the north slope to a 4:1 horizontal:vertical grade. Berms will be placed along the sides of the road to direct storm flows to an area where a rock section will protect the reclaimed slopes and direct water to the new culvert inlet and outlet. Construction

will involve approximately 400 feet of new road construction and the associated side slopes. The new 30-inch high density polyethylene (HDPE) culvert is oversized to allow for possible future development and avoid having to excavate the reclaimed area. The disturbed area will be reclaimed with Agency-approved caps, a 12-inch rock section, or a standard 18-inch cover according to the Butte Hill Revegetation Specifications (EPA, 2006). The storm water outfalls from this site will continue to be directed to the Alice Pit complex. The majority of the property under construction is owned by Atlantic Richfield Company with the exception of a small area at the toe of the existing south slope. If work is required on private property then access agreements will be obtained before work begins. The site was hydrologically analyzed and the data used in the design to accommodate a Soil Conservation Service 25-year type 1 storm event (Appendix D). The purpose of the Project remedial action is to mitigate failed storm water infrastructure issues, cap areas with elevated metals concentrations, and provide a widened roadway section with berms to direct runoff to a centralized location.

3.0 DESCRIPTION OF RESPONSIBILITIES

Pioneer Technical Services, Inc. (Pioneer) will oversee completion of the work and notify the interested agencies and organizations of the project status. An independent contractor will provide a foreman/supervisor and all other labor, equipment, and materials necessary to complete the work.

4.0 DESCRIPTION OF WORK

The Project is scheduled for completion in the 2017 construction season. The contractor will complete the site work using various measures such as site grading, cap and cover, revegetation, rock sections, rock outfalls, road construction, and culvert installation.

The objective of the design for the Project (Appendix D) is to mitigate storm flow blockages, flatten roadside slopes, widen a narrow road section, cap metals-impacted areas, and vegetate barren areas. The Project design controls storm water flows and possible erosion in reclaimed areas. Remediation activities will follow the design shown on the Construction Drawings (Appendix B) and as detailed in the Technical Specifications (Appendix C).

5.0 CONSTRUCTION DRAWINGS AND TECHNICAL SPECIFICATIONS

Appendix B contains Construction Drawings and Appendix C contains Technical Specifications for the project.

6.0 POST-CONSTRUCTION OPERATIONS AND MAINTENANCE

Once the Project is complete, post-construction operations will consist of monitoring the performance and providing as-needed maintenance of the installed infrastructure. Post-construction O&M activities will remain the responsibility of Walkerville. Pioneer will document the construction activities and draft As-Built Drawings.

7.0 REFERENCES

EPA, 2011. Unilateral Administrative Order for Partial Remedial Design/Remedial Action Implementation and Certain Operation and Maintenance at the Butte Priority Soils Operable Unit/Butte Site. July 2011.

EPA, 2006. Record of Decision, Butte Priority Soils Operable Unit Silver Bow Creek/Butte Area NPL Site. September 2006. Butte Hill Revegetation Specifications are Appendix B of Appendix E (BRES).

Appendix A

Soil Testing

Index	Reading No	Time	Type	Duration	Units	Sigma Value	Sequence	SAMPLE	LOCATION	INSPECTOR	Cu	Cu Error	Zn	Zn Error	As	As Error	Cd	Cd Error	Pb	Pb Error
1	128	5/31/2017 14:16	Soil	30	ppm		2 Final	East # 1 0-6"(1)	Ryan Road		332.02	21.49	737.37	25.31	50.33	8.31	0		142.9	10.72
2	129	5/31/2017 14:17	Soil	30	ppm		2 Final	East # 1 0-6"(2)	Ryan Road		319.58	21.24	496.49	21.15	45.88	8.37	0		149.98	10.95
3	130	5/31/2017 14:18	Soil	30	ppm		2 Final	East # 1 0-6"(3)	Ryan Road		316.74	22.01	478.96	21.58	49.32	8.91	0		161.41	11.61
4	131	5/31/2017 14:19	Soil	30	ppm		2 Final	East # 1 6-12"(1)	Ryan Road		246.11	19.66	209.92	14.74	27.26	5.94	0		43.85	7.66
5	132	5/31/2017 14:21	Soil	30	ppm		2 Final	East # 1 6-12"(2)	Ryan Road		1012.58	33.75	948.03	28.53	35.53	9.83	0		263.78	13.54
6	133	5/31/2017 14:23	Soil	30	ppm		2 Final	East # 1 6-12"(3)	Ryan Road		428.7	24.01	450.89	20.52	41.2	8.38	0		150.18	11.08
7	134	5/31/2017 14:25	Soil	30	ppm		2 Final	East # 2 0-6"(1)	Ryan Road		316.69	21.29	892.62	27.91	127.5	17.76	0		925.7	24.15
8	135	5/31/2017 14:26	Soil	30	ppm		2 Final	East # 2 0-6"(2)	Ryan Road		469.6	31.13	2488.32	55.78	731.67	41.71	18.64	9.16	3276.26	54.23
9	136	5/31/2017 14:28	Soil	30	ppm		2 Final	East # 2 0-6"(3)	Ryan Road		439.23	29.08	2393.08	52.74	464.75	29.44	0		1648.31	37.39
10	137	5/31/2017 14:30	Soil	30	ppm		2 Final	East # 2 6-12"(1)	Ryan Road		414.44	23.17	263.26	15.99	196.68	16.76	0		742.8	21.56
11	138	5/31/2017 14:30	Soil	30	ppm		2 Final	East # 2 6-12"(2)	Ryan Road		149.41	17.01	131.15	12.35	113.78	15.44	0		637.93	20.64
12	139	5/31/2017 14:31	Soil	30	ppm		2 Final	East # 2 6-12"(3)	Ryan Road		293.08	20.34	249.97	15.49	239.76	11.8	0		180.96	11.64
13	140	5/31/2017 14:33	Soil	30	ppm		2 Final	West # 1 0-6"(1)	Ryan Road		450.15	25.63	201.6	15.27	348.26	17.45	0		528.97	19.55
14	141	5/31/2017 14:34	Soil	30	ppm		2 Final	West # 1 0-6"(2)	Ryan Road		529.48	27.51	208.45	15.63	368.65	17.76	0		528.24	19.65
15	142	5/31/2017 14:35	Soil	30	ppm		2 Final	West # 1 0-6"(3)	Ryan Road		495.88	26.31	222.46	15.76	406.01	17.56	0		490.74	18.74
16	143	5/31/2017 14:36	Soil	30	ppm		2 Final	West # 1 6-12"(1)	Ryan Road		807.64	30.61	736.41	25.45	218.32	21.57	0		1385.32	28.99
17	144	5/31/2017 14:37	Soil	30	ppm		2 Final	West # 1 6-12"(2)	Ryan Road		617.87	26.73	497.49	20.78	143.45	17.61	0		953.26	23.78
18	145	5/31/2017 14:38	Soil	30	ppm		2 Final	West # 1 6-12"(3)	Ryan Road		355.03	22.1	209.63	14.6	79.06	10.38	0		243.83	13.28
19	146	5/31/2017 14:40	Soil	30	ppm		2 Final	West # 2 0-6"(1)	Ryan Road		456.54	25.88	370.93	19.8	134.86	22.33	0		1388.63	30.92
20	147	5/31/2017 14:41	Soil	30	ppm		2 Final	West # 2 0-6"(2)	Ryan Road		342.21	21.3	334.58	17.44	110.43	15.44	0		707.56	20.84
21	148	5/31/2017 14:42	Soil	30	ppm		2 Final	West # 2 0-6"(3)	Ryan Road		430.82	24.32	521.32	22.13	146.69	18.45	0		952.52	24.89
22	149	5/31/2017 14:43	Soil	30	ppm		2 Final	West # 2 6-12"(1)	Ryan Road		320.92	20.98	369.58	18.36	80.22	12.3	0		413.67	16.41
23	150	5/31/2017 14:45	Soil	30	ppm		2 Final	West # 2 6-12"(2)	Ryan Road		321.97	20.56	341.36	17.36	18.7	6.87	0		110.95	9.5
24	151	5/31/2017 14:46	Soil	30	ppm		2 Final	West # 2 6-12"(3)	Ryan Road		501.84	26.22	477.34	21.6	47.94	12.01	21.76	7.73	379.97	16.5

Screening Levels (ppm)

Copper	1000
Zinc	1000
As	1000
Cd	20
Pb	2300

	Above Screening Level
	Above Screening Level including error



Appendix B

Construction Drawings

SCRAP H ROAD

SHEET INDEX

SHEET NO.	DESCRIPTION
G1	COVER
1 OF 8	SCRAP H ROAD ROAD SECTION PLAN VIEW
2 OF 8	SCRAP H ROAD ROAD SECTION PROFILE VIEW
3 OF 8	SCRAP H ROAD ROAD SECTION X-SECTIONS STA. 0+10 TO 2+00
4 OF 8	SCRAP H ROAD ROAD SECTION X-SECTIONS STA. 2+25 TO 3+50
5 OF 8	SCRAP H ROAD ROAD SECTION X-SECTIONS STA. 3+75 TO 4+00
6 OF 8	SCRAP H ROAD ROAD ALIGNMENT TOTAL CUT FILL VOLUMES
7 OF 8	SCRAP H ROAD ROAD SECTION TYPICAL SECTION RIPRAP APRON
8 OF 8	SCRAP H ROAD 30" HDPE CULVERT PROFILE VIEW



PREPARED FOR

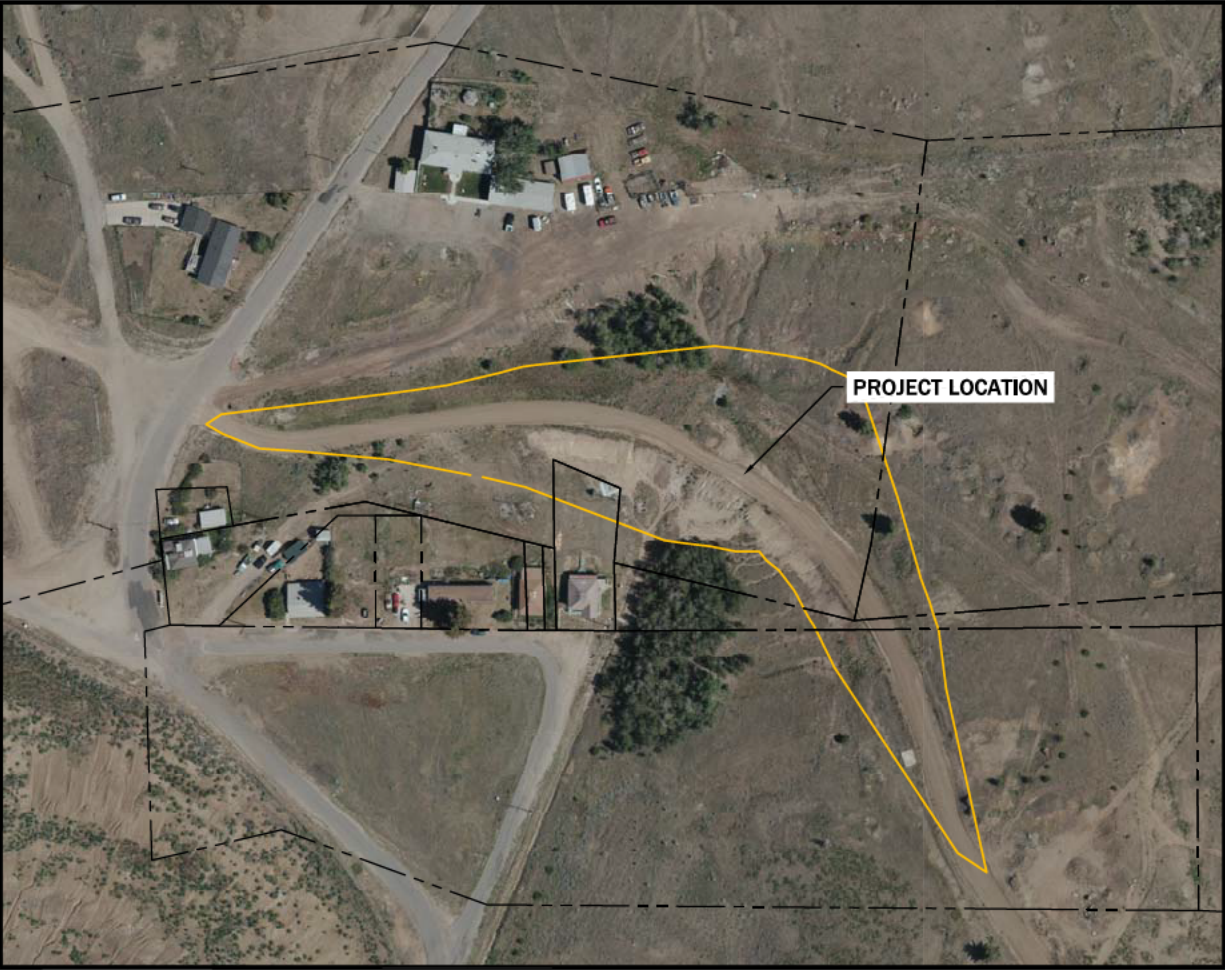
ATLANTIC RICHFIELD COMPANY



PREPARED BY

PIONEER TECHNICAL SERVICES, INC.

AUGUST 4, 2017



SITE VICINITY MAP

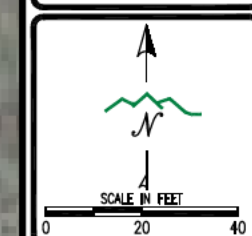




REVISION		
DATE	BY	DESC.

DRAWN BY: CLJ/SJK
DESIGNED BY: LID
CHECKED BY: AGC
APPROVED BY: LID
PROJECT NO:
DATE: JULY 2017

DISPLAYED AS:
COORD SYS/ZONE: MSP
DATUM: NAD 83
UNITS: FEET
SOURCE: PIONEER



ATLANTIC RICHFIELD
BPSOU
SCRAP H CULVERT

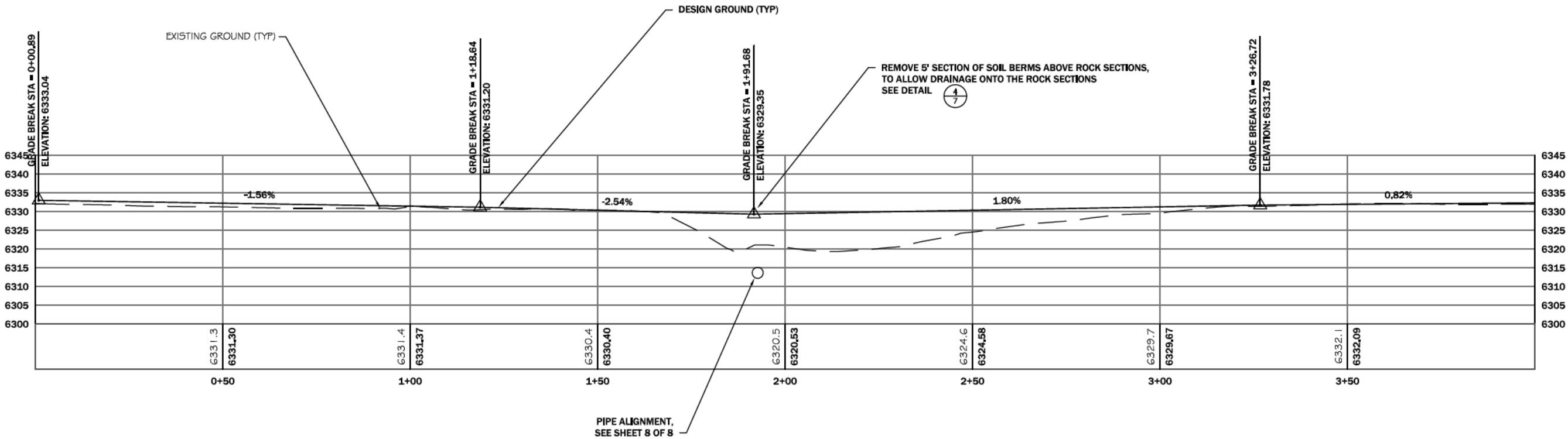
SCRAP H ROAD
ROAD SECTION
PLAN VIEW



SHEET
1 OF 8

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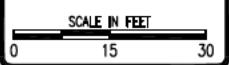
Scrap H Road Alignment



REVISION		
DATE	BY	DESC.

DRAWN BY: CLJ/SKK
DESIGNED BY: LJD
CHECKED BY: AIC
APPROVED BY: LJD
PROJECT NO:
DATE: JULY 2017

DISPLAYED AS:
COORD SYS/ZONE: MSP
DATUM: NAD 83
UNITS: FEET
SOURCE: PIONEER

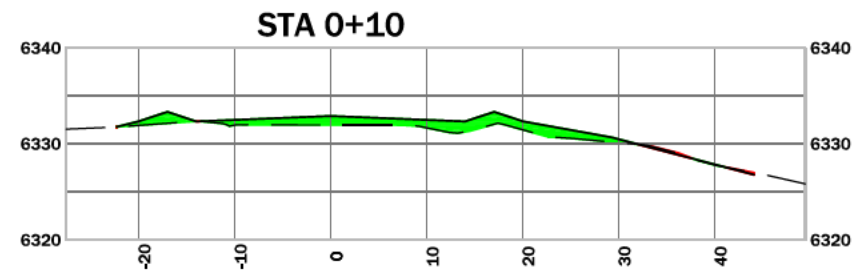
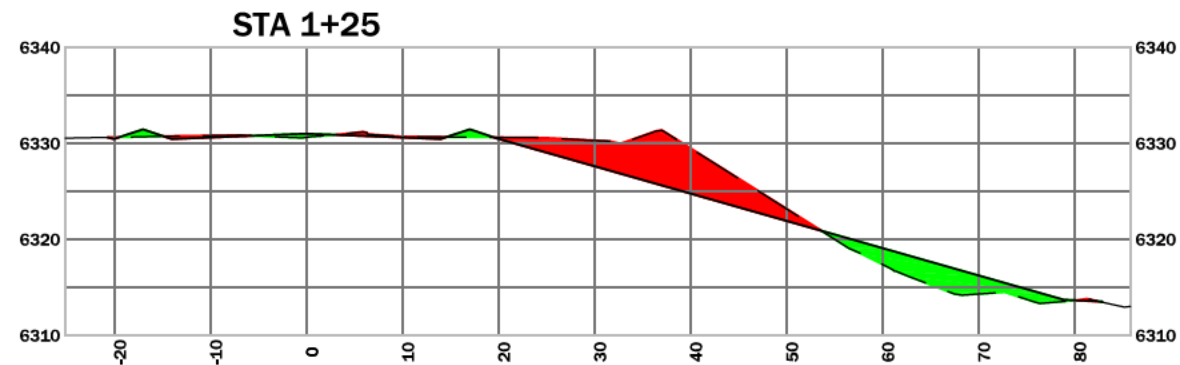
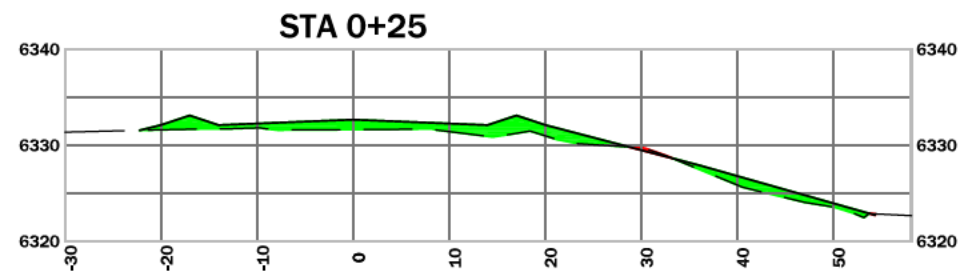
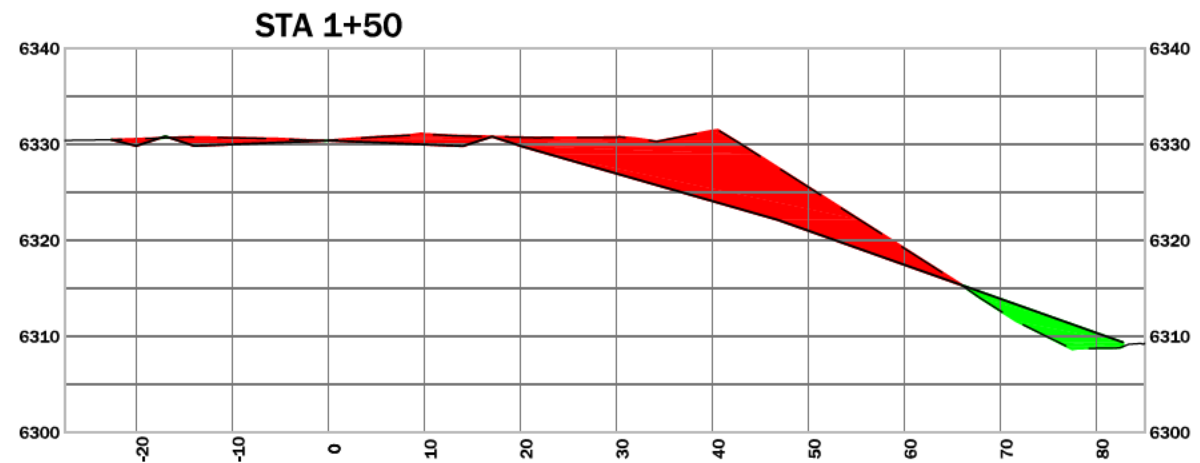
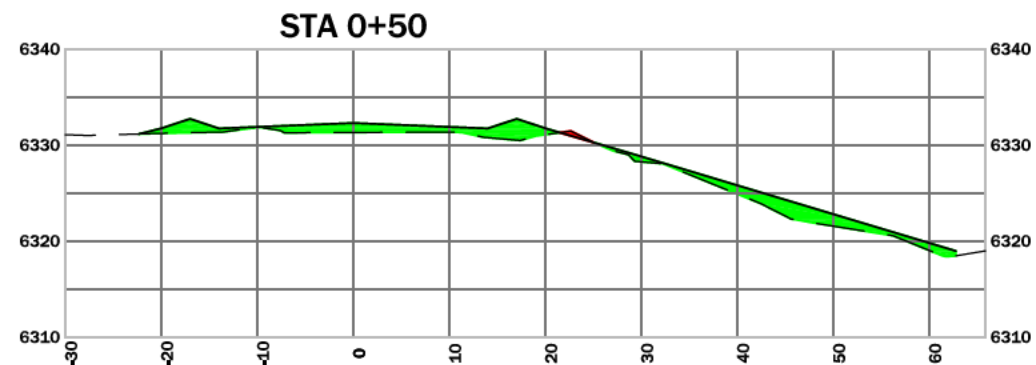
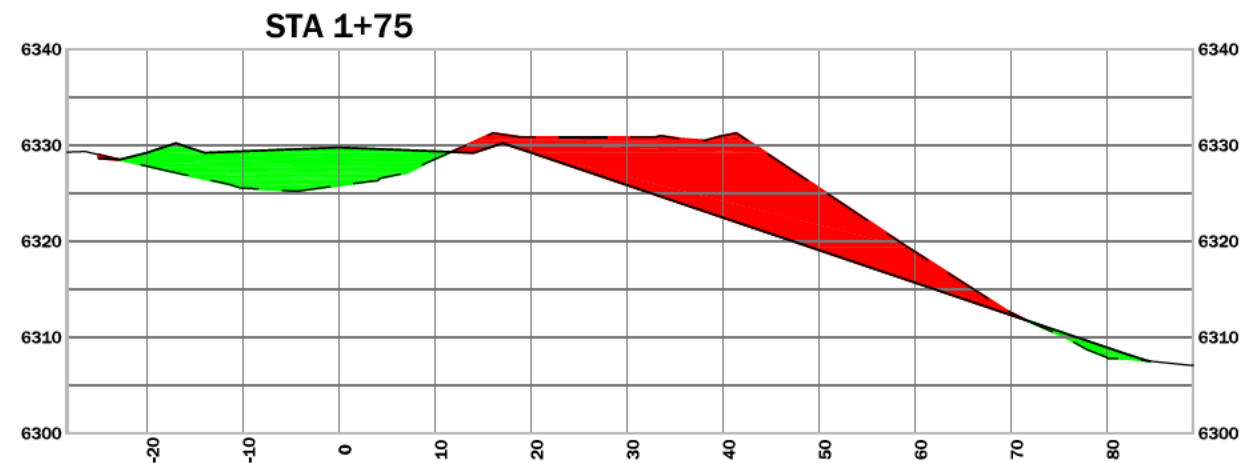
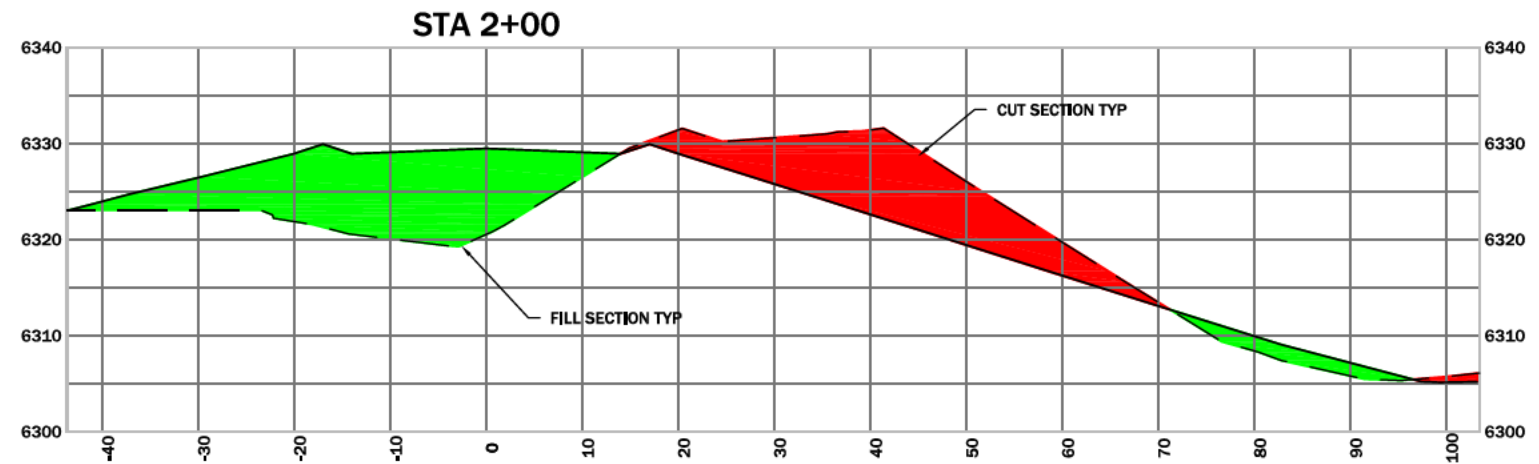
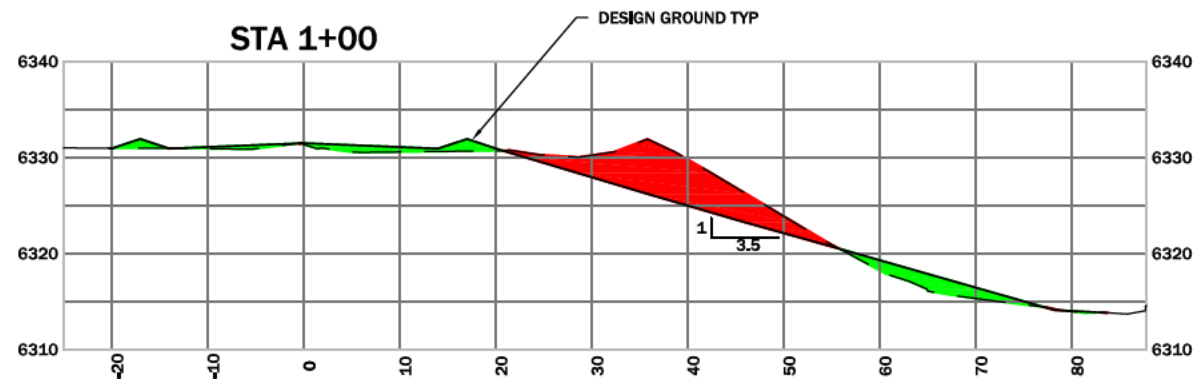


ATLANTIC RICHFIELD
BPSOU
SCRAP H CULVERT

SCRAP H ROAD
ROAD SECTION
PROFILE



SHEET
2 OF 8



REVISION	DATE	BY	DESC.

DRAWN BY: CLJ/SKK
 DESIGNED BY: LJD
 CHECKED BY: JAC
 APPROVED BY: LJD
 PROJECT NO:
 DATE: JULY 2017

DISPLAYED AS:
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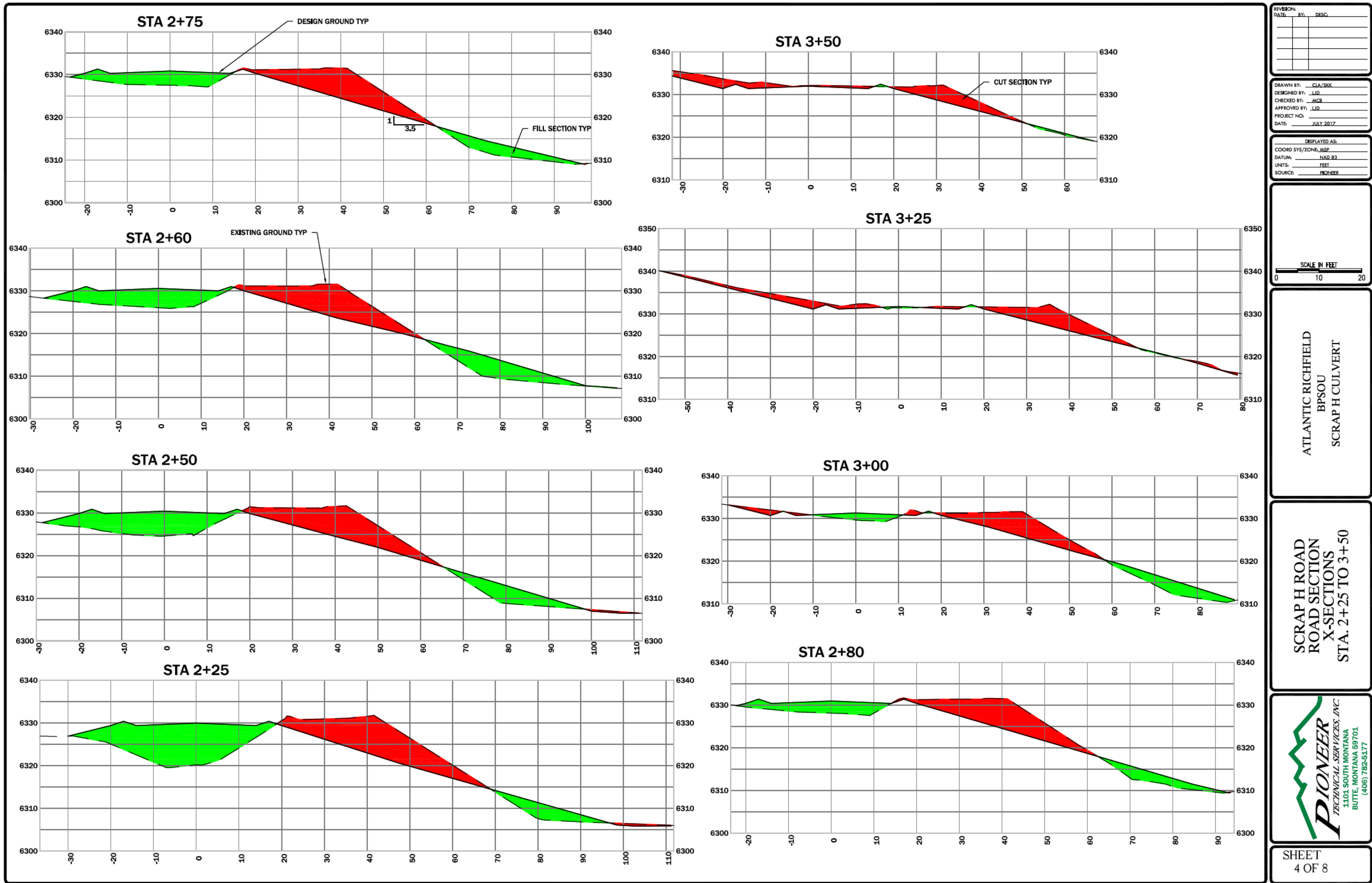
SCALE IN FEET
 0 10 20

ATLANTIC RICHFIELD
 BPSOU
 SCRAPH CULVERT

SCRAPH ROAD
 ROAD SECTION
 X-SECTIONS
 STA. 0+10 TO 2+00

PIONEER
 TECHNICAL SERVICES, INC.
 1101 SOUTH MONTANA
 BUTTE, MONTANA 59701
 (406) 782-5177

SHEET
 3 OF 8



REVISION	DATE	BY	DESC.

DRAWN BY: CLJ/SKK
DESIGNED BY: LJD
CHECKED BY: AJC
APPROVED BY: LJD
PROJECT NO:
DATE: JULY 2017

DISPLAYED AS:
COORD SYS/ZONE: MSP
DATUM: NAD 83
UNITS: FEET
SOURCE: PIONEER

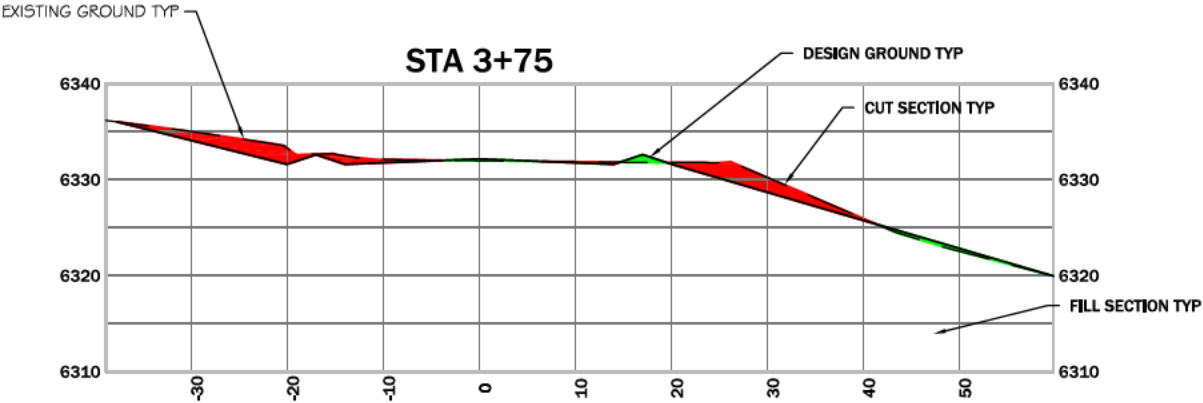
SCALE IN FEET
0 10 20

ATLANTIC RICHFIELD
BPSOU
SCRAPP H CULVERT

SCRAPP H ROAD
ROAD SECTION
X-SECTIONS
STA. 2+25 TO 3+50

PIONEER
TECHNICAL SERVICES, INC.
1101 SOUTH MONTANA
BUTTE, MONTANA 59701
(406) 782-5177

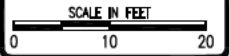
SHEET
4 OF 8



REVISION		
DATE	BY	DESC.

DRAWN BY:	
DESIGNED BY:	
CHECKED BY:	
APPROVED BY:	
PROJECT NO:	
DATE:	JULY 2017

DISPLAYED AS:	
COORD SYS/ZONE:	
DATUM:	
UNITS:	
SOURCE:	



ATLANTIC RICHFIELD
BPSOU
SCRAP H CULVERT

SCRAP H ROAD
ROAD SECTIONS
X-SECTIONS
STA. 3+75 TO 4+00



SHEET
5 OF 8

Road Subgrade Total Volume Table						
Station	Fill Area	Cut Area	Fill Volume	Cut Volume	Cumulative Fill Vol	Cumulative Cut Vol
0+10.00	40.02	1.06	0.00	0.00	0.00	0.00
0+25.00	56.56	0.74	26.83	0.50	26.83	0.50
0+50.00	63.49	0.87	55.58	0.75	82.41	1.25
0+75.00	45.56	26.42	49.27	12.36	131.68	13.61
1+00.00	38.29	91.68	38.82	54.68	170.50	68.28
1+25.00	43.89	93.47	22.61	58.80	193.11	127.08
1+50.00	26.20	194.58	32.45	133.35	225.56	260.44
1+75.00	106.59	253.32	54.54	143.55	280.10	403.99
2+00.00	346.02	260.67	209.54	237.96	489.64	641.95
2+25.00	347.36	246.15	314.30	174.97	803.95	816.92
2+50.00	249.31	190.99	253.94	152.98	1057.89	969.89
2+60.00	232.77	177.19	89.27	68.18	1147.16	1038.07
2+75.00	152.82	168.58	107.11	96.05	1254.27	1134.12
2+80.00	121.89	164.35	25.44	30.83	1279.71	1164.95
3+00.00	82.68	127.33	56.08	80.39	1335.78	1245.34
3+25.00	4.21	134.87	30.69	106.76	1366.47	1352.10
3+50.00	5.36	104.94	3.29	98.97	1369.77	1451.08
3+50.00	5.36	104.94	3.29	98.97	1369.77	1451.08
3+75.00	6.72	47.25	3.11	21.87	1372.88	1472.95

REVISION:		
DATE	BY	DESC.

DRAWN BY: _____

DESIGNED BY: LID _____

CHECKED BY: _____

APPROVED BY: _____

PROJECT NO: _____

DATE: JULY 2017

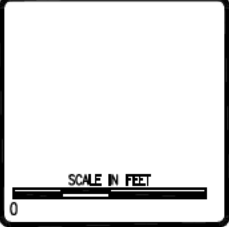
DISPLAYED AS:

COORD SYS/ZONE: _____

DATUM: _____

UNITS: _____

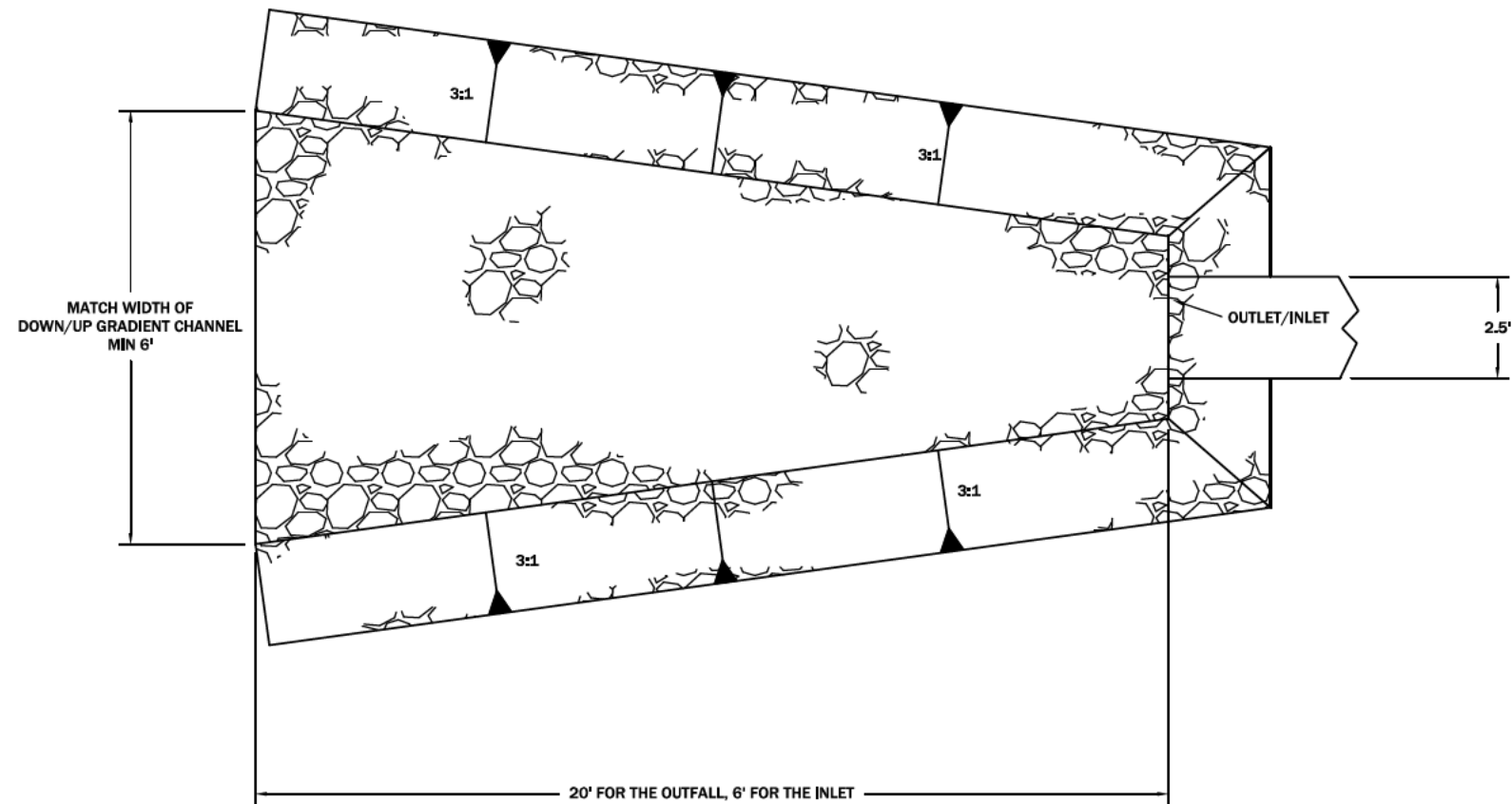
SOURCE: _____



ATLANTIC RICHFIELD
BPSOU
SCRAP H CULVERT

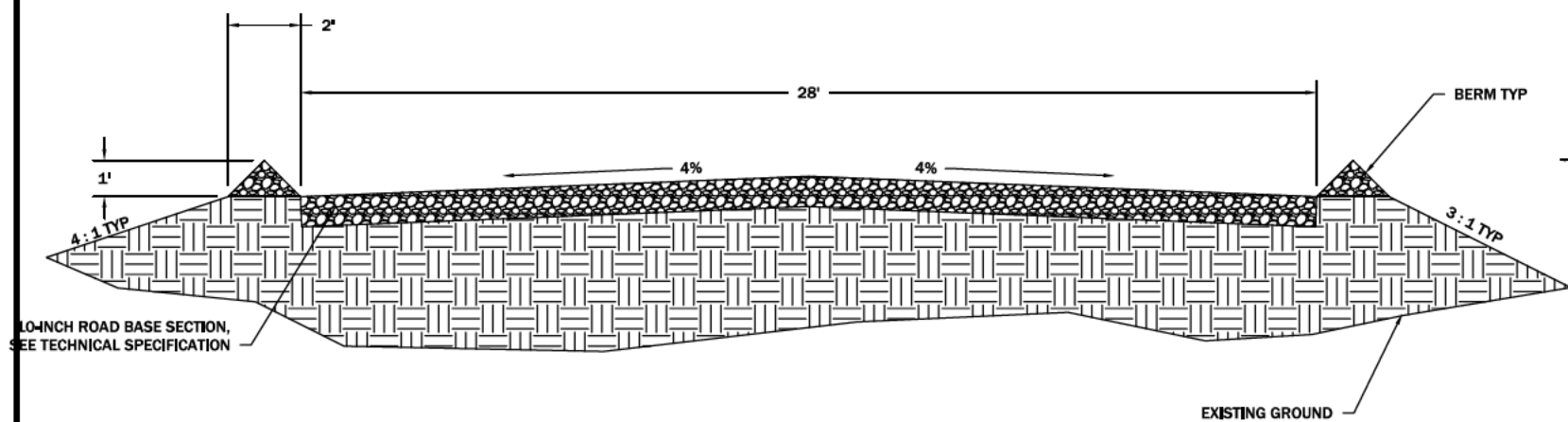
SCRAP H ROAD
ROAD ALIGNMENT
TOTAL
CUT FILL VOLUMES



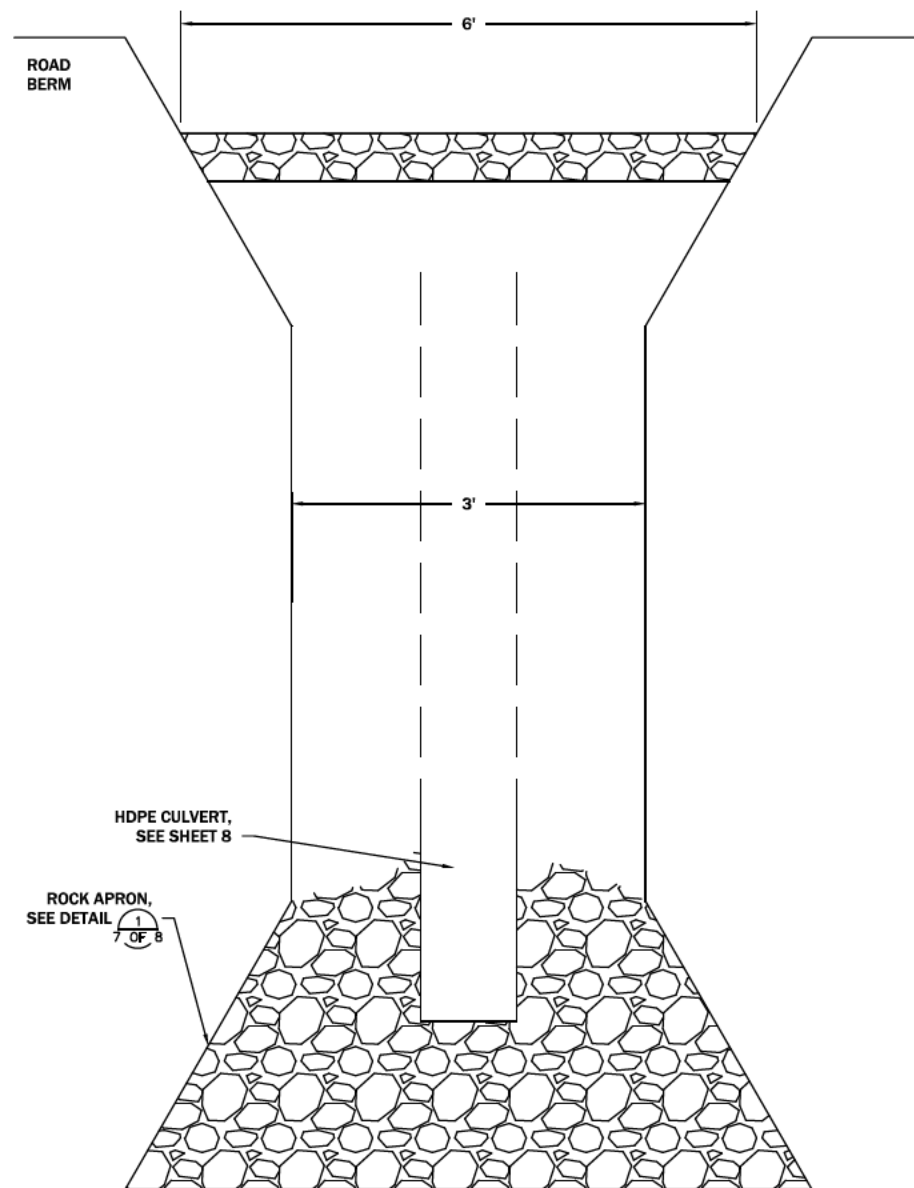


NOTE: CONSTRUCT OUTFALL/INLET FROM 1-FOOT MINUS RIPRAP SEE TECHNICAL SPECIFICATION 02260

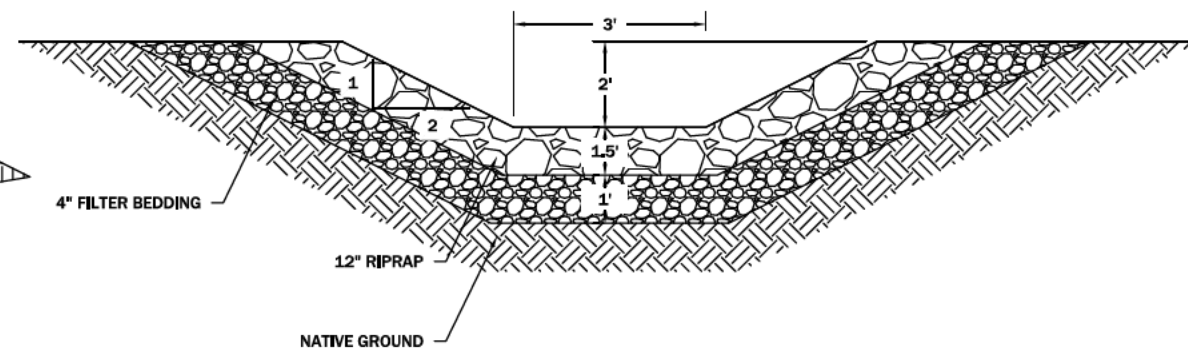
RIPRAP APRON FOR CULVERT DETAIL (1) N.T.S.



ROAD TYPICAL SECTION DETAIL (2) N.T.S.



BERM CUTOUT (TYP) (4) N.T.S.



ROCK SECTION (3) N.T.S.

REVISION	DATE	BY	DESC.

DRAWN BY: LID
 CHECKED BY:
 APPROVED BY:
 PROJECT NO:
 DATE: JULY 2017

DISPLAYED AS:
 COORD SYS/ZONE:
 DATUM:
 UNITS:
 SOURCE:

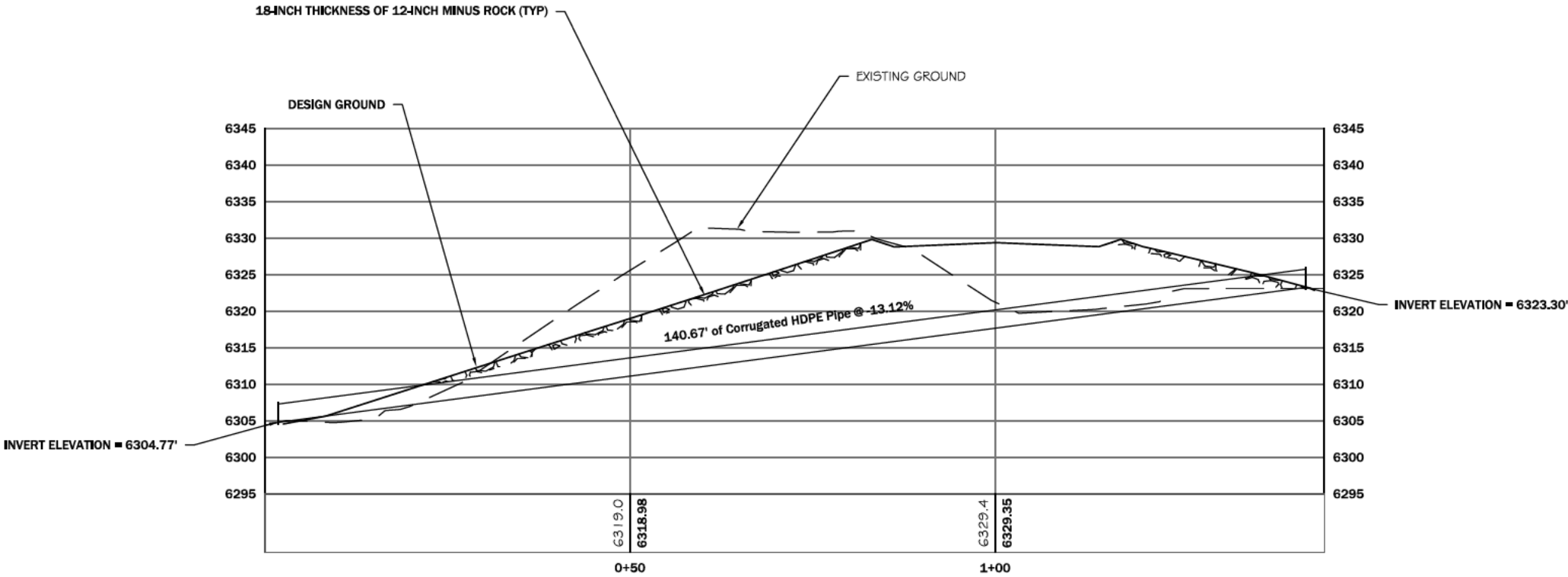


ATLANTIC RICHFIELD
 BPSOU
 SCRAPH CULVERT

SCRAPH ROAD
 ROAD SECTION
 TYPICAL SECTION
 RIPRAP APRON

PIONEER
 TECHNICAL SERVICES, INC.
 1101 SOUTH MONTANA
 BUTTE, MONTANA 59701
 (406) 782-5177

Culvert Alignment



NOTE:
PROVIDE AND INSTALL 140 LF OF 30" HDPE CORRUGATED CULVERT
SEE TECH SPEC 02751.

REVISION		
DATE	BY	DESC.

DRAWN BY: _____
DESIGNED BY: LJD
CHECKED BY: _____
APPROVED BY: _____
PROJECT NO: _____
DATE: JULY 2017

DISPLAYED AS:
COORD SYS/ZONE: _____
DATUM: _____
UNITS: _____
SOURCE: _____

SCALE IN FEET
0 5 10

ATLANTIC RICHFIELD
BPSOU
SCRAP H CULVERT

SCRAP H ROAD
30" HDPE CULVERT
PROFILE VIEW

PIONEER
TECHNICAL SERVICES, INC.
1101 SOUTH MONTANA
BUTTE, MONTANA 59701
(406) 782-5177

SHEET
8 OF 8

Appendix C

Technical Specifications

TECHNICAL SPECIFICATIONS

for
BPSOU
SCRAP H ROAD INSTALLATION

Prepared for:

Atlantic Richfield Company
317 Anaconda Road
Butte, Montana 59701

Prepared by:

Pioneer Technical Services, Inc.
P.O. Box 3445
Butte, Montana 59702

August 2017

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SECTION 01000
GENERAL PROCEDURES

A. TEMPORARY FACILITIES AND SITE CONTROL

1. Contractor shall implement an appropriate program to protect the work in progress and Atlantic Richfield Company's operations from theft, vandalism, and unauthorized entry.
2. Contractor shall provide temporary parking areas for project personnel.
3. Contractor shall use only those haul roads outside of the Project Area boundaries as approved by Atlantic Richfield Company prior to hauling. Contractor shall maintain all haul roads in good condition. Contractor shall provide dust control to ensure that dust levels are minimized, and to comply with current standards.
4. Contractor shall notify and coordinate with all appropriate utility companies and Atlantic Richfield Company before conducting work proximate to overhead and buried utilities.
5. Contractor shall only cross the existing railroad at existing crossings or newly installed crossings as approved by the railroad Owner and Atlantic Richfield Company. The railroad Owner has the right to limit the crossings where loaded haul trucks will be allowed to cross.
6. Contractor shall contact the utility owner to determine cover or clearance requirements of the existing utilities. The Contractor shall be responsible for improving existing roads or installing new roads so that they will satisfy these requirements.

B. SURVEYING

1. Construction staking services for control points, reference grid, initial location of site structures, initial setting of centerlines, and surveys to determine pay quantities will be provided by Atlantic Richfield Company. Contractor shall be responsible for providing all other surveying and staking requirements necessary to conduct the Work.
2. Original Survey Control monuments will be furnished by Atlantic Richfield Company, and are shown on the Construction Drawings. Maintenance of the original staking is the obligation of the Contractor. Any additional staking is at the Contractor's expense.

3. A licensed land surveyor shall reset any property corner or monument, including MDT Right of Way markers; that are damaged or buried by Contractor due to Construction, at the expense of the Contractor. Contractor shall reset all survey monuments disturbed or buried during the RA. A licensed surveyor shall complete all Work.

C. SUBMITTALS

1. The Contractor shall provide to Atlantic Richfield Company complete product information and shop drawings, where required, for all materials and equipment proposed for incorporation into the project. Information shall include manufacturer, model or catalog designation, reference standards, complete installation instructions, and shop drawings that show dimensions and locations of all parts. Information shall be submitted prior to ordering, and in a timely manner to provide Atlantic Richfield Company time for review and approval.
2. In connection with all of the activities described in these Technical Specifications, the Contractor shall be responsible and shall notify Atlantic Richfield Company and Atlantic Richfield Company's representatives of any governmental laws or regulations, in addition to those identified in these specifications and the Individual Site Work Plan (ISWP), including those relating to environmental protection and zoning, that would regulate, prohibit or control the Contractor's performance under these Technical Specifications.

D. SITE SAFETY AND CONTROL OF WORK

All Work will be performed in a safe manner and will conform to Atlantic Richfield Company's Control of Work criteria.

E. TRAFFIC CONTROL

Traffic control shall be the sole responsibility of the Contractor. Adequate signs, barricades, cones, drums, barriers, lighting, persons or flaggers, security guards, and other methods or devices shall be utilized. Contractor is responsible for coordinating site access work hours, safety barriers, etc. with the affected property owner(s).

F. EROSION AND SEDIMENT CONTROL

The Contractor shall plan and execute work to control and minimize surface runoff from cuts, fills, and other disturbed areas. The Contractor shall prevent sediment and/or sediment-laden water from entering nearby waterways.

G. CONSTRUCTION SEQUENCING AND OTHER CONTRACTORS

1. The Contractor shall coordinate his construction activities with those of any and all other contractors that may be working on the site. The Contractor's work shall be conducted in a manner that will not impede the progress of other concurrent construction activities, or landowner activities.

2. Debris disposal or equipment removal/relocation is the sole responsibility of the landowner. The Contractor shall coordinate his construction activities in a manner which allows the landowner a reasonable amount of time to remove debris from the site.

H. EXISTING STRUCTURES

1. The contractor shall be responsible for protecting existing structures within and external to the construction area. Damage to existing structures shall be corrected by the Contractor at no additional cost to Atlantic Richfield Company.

I. COMMUNICATIONS

All notices, demands, requests, instructions, approvals, proposals, and claims by the Contractor must be in writing. All correspondence is required to be delivered to Atlantic Richfield Company, unless otherwise specified in writing to the Contractor.

J. PROGRESS MEETINGS

Project coordination will be facilitated through job site meetings held weekly. At a minimum, the Contractor's on-site Project Manager, Health and Safety Manager, and appropriate field personnel shall be present at the progress meetings. The Contractor shall develop the agenda, and record and distribute meeting minutes for the progress meetings. The topics shall include but not be limited to the following:

1. Health and safety issues;
2. Status of work items initiated to date;
3. Scheduled items for the following week;
4. Quality Control and Quality Assurance;
5. Problems encountered and proposed solutions;
6. Other items identified by Atlantic Richfield Company or Contractor; and
7. Coordination of work activities with property owner(s).

A landowner site walk is required with Atlantic Richfield Company and/or their representative(s), agency personnel and other as required prior to commencement of work. Meeting minutes will be incorporated into the project records.

K. RECORD KEEPING REQUIREMENTS

The contractor shall maintain on-site, at all times, a complete set of all Contract Documents, addenda, change orders, and other modifications to the Work.

The Contractor shall be responsible for furnishing detailed Project Record Documents (Record Drawings). Record Drawings may be submitted on grid paper drawn at the proper scale. Record Drawings must be updated on a weekly basis; and an updated Project Record Document must be attached with final Application for Payment (unless waived by Atlantic Richfield Company).

L. STANDARD SPECIFICATIONS

The Technical Specifications for the ISWP are supplemented by the Montana Public Works Standard Specifications, Latest Edition (Standard Specifications).

In performance of the Work, these Technical Specifications shall take precedence over the Standard Specifications. If, during the performance of the Work, the Contractor finds a conflict, error or discrepancy between the Technical Specifications and the Standard Specifications, the conflict, error or discrepancy shall be reported to Atlantic Richfield Company at once, before proceeding with the affected Work. The Contractor may proceed with the work only after receiving a written interpretation or clarification from Atlantic Richfield Company.

END OF SECTION 01000

SECTION 01300

SUBMITTALS

A. GENERAL

1. **DESCRIPTION:** The following specification includes the procedures for submitting “Shop Drawings” as is required in these specifications. Items that need to be reviewed by the ENGINEER are included with this specification. Also refer to the “Submittal” section of each Technical Specification section for additional requirements.
2. **DEFINITIONS:**
 - a. **Shop Drawings:** The term “shop drawings” includes drawings, diagrams, layouts, schematics, descriptive literature, manufacturer’s information, illustrations, schedules, performance and test data, and similar materials requested by the ENGINEER to be furnished by the CONTRACTOR to explain in detail specific portions of the Work required by the Contract.
 - b. **CONTRACTOR’S Review and Approval:** The CONTRACTOR shall coordinate all submittals and review them for accuracy, completeness, and compliance with contract requirements and shall indicate his approval thereon as evidence of such coordination and review. All submittals shall be attached to the “Shop Drawing Submission” Form that is included in this Contract Document. The form shall be filled out, signed and stamped by the CONTRACTOR. Items submitted to ENGINEER without this form or CONTRACTOR’S stamp and approval will be returned for resubmission. By attaching this form to the submittal, the CONTRACTOR is representing that he has reviewed the entire submittal, that the submittal is in compliance with the Contract Documents, except as noted, and that the cover form applies to all documents that are attached to the form.

B. PRODUCTS

1. NONE.

C. EXECUTION

1. **SUBMITTAL PROCEDURE:** Shop Drawings shall be submitted as follows:
 - a. **Date and Number:** CONTRACTOR shall forward to ENGINEER all submittals required by the individual sections of the specifications. All submittals shall be returned to the CONTRACTOR within 7 days following their initial review. If follow-up reviews are required they shall be reviewed within 5 days. Unless a different number is called for in the individual sections, submit six copies of each shop drawing, six copies of all operation and maintenance instructions, and four specimens of each sample requested, of which all but two copies will be retained by ENGINEER. The other copies shall be returned to the CONTRACTOR along

with the ENGINEER'S comments. If the CONTRACTOR wants more than two copies sent to him he shall submit whatever additional copies he desires.

- b. Cover Letter: All submittals shall be forwarded with a cover letter from the CONTRACTOR, identifying the project and the portion of the project to which it applies. Submittals that are related to or affect each other shall be forwarded simultaneously as a package to facilitate a coordinated review. Uncoordinated submittals will be rejected.
- c. Modifications: Any modifications to the design proposed by the CONTRACTOR, shall be fully explained in the submittal. All necessary calculations and supporting documentation shall be included. If requested by the ENGINEER, the CONTRACTOR shall provide design drawings of the modification stamped by a professional engineer licensed to practice in the State of Montana.

D. ENGINEER'S APPROVAL

The ENGINEER will indicate his approval or disapproval of each submittal and, if he does not approve the submittal as submitted, will indicate his reasons therefore. Any work done prior to approval shall be at the CONTRACTOR'S own risk. Neither approvals nor lack of reviews or approval shall relieve the CONTRACTOR from responsibility for supplying materials and performing all work in accordance with the requirements of these Contract Documents. If submittals show variations from the Contract requirements, the CONTRACTOR shall describe such variations in writing, on the before mentioned form at the time of submission. Approval of such variation(s) shall be accompanied with a Contract Modification. Minor variations not involving a change in price or time of performance will not be issued a modification.

E. REQUIRED SUBMITTALS

1. Permits: Submit to the ENGINEER a copy of all permits required by the governing authorities, for which the CONTRACTOR is responsible.
2. Subcontractors: The CONTRACTOR shall supply a list of all suppliers and subcontractors to be used on the project.
3. Certificates: For those items called for in individual sections, furnish certificates from manufacturers, suppliers, or others certifying that materials or equipment being furnished under the Contract comply with the requirements of these specifications.
4. Shop Drawings: Including all materials and equipment supplied on the project. See the individual sections for specific requirements. If an alternate is proposed, explain fully and if approved, make all necessary adjustments needed to accommodate any differences in the product.
5. Progress Schedule and Sequence of Work Schedule: The CONTRACTOR shall submit to the ENGINEER, with the completed Agreement a Progress Schedule and Sequence of

Work Schedule. The Sequence of Work Schedule shall show the order in which work shall be undertaken by the CONTRACTOR and shall show which items of Work shall be going on simultaneously. The Progress Schedule shall show estimated starting and completion dates for each part of the Work. The Progress Schedule shall be revised monthly to show project progress revisions to the schedules. The revised schedule shall be submitted monthly.

If the CONTRACTOR is behind schedule, he shall also submit a plan as to how he will get back on schedule.

6. Site-Specific Safety and Health Plan:

CONTRACTOR shall submit a written site specific Safety and Health Plan prior to commencing work. The plan, at a minimum, shall include:

- Site Characterization;
- Description of Work Summary;
- Location Map and Site Characteristics;
- Emergency Response Plans;
- Security Arrangements/Instructions;
- Physical and Chemical Hazard Analyses;
- Specific Task Job Safety Analyses (JSA) for all work tasks;
- Authorization to Work Procedures;
- PPE Requirements;
- Medical Surveillance;
- Permits Required;
- Decontamination Procedures;
- Site Sanitation Requirements;
- Standard Operating Procedures;
- Heavy Equipment Operational Safety;
- Underground and Overhead Utilities;
- Trenching and Excavation;
- Confined Space;
- Hand and Power Tools;
- Hearing Conservation;
- Electrical Safety;
- Fall Protection;
- Fire Prevention;
- Respiratory Protection;
- Site Authorities and Responsibilities;
- Applicable MSDS's;
- Kick-off Meeting Content/Project Safety Reviews; and
- Sign-Off Lines.

7. Traffic Control Program: CONTRACTOR to provide as required in Section 05500.

8. Materials Samples: CONTRACTOR shall also submit to ENGINEER for review and approval with such promptness as to cause no delay in Work, all samples required by the Contract Documents. All samples will have been checked by and accompanied by a specific written indication that CONTRACTOR has satisfied CONTRACTOR'S responsibilities under the Contract Documents with respect to the review of the submission and will be identified clearly as to material, Supplier, pertinent data such as catalog numbers and the use for which intended.
9. Closeout Submittals: CONTRACTOR to provide all required closeout submittals.

TRANSMITTAL OF SHOP DRAWINGS			DATE		NEW SUBMITTAL		RESUBMITTAL
Pioneer Technical Services, Inc. P.O. Box 3445 63 ½ West Broadway Butte, Montana 59702 ATTN: CC:			FROM:			TRANSMITTAL NO.	
						PROJECT NO.	
			PROJECT TITLE AND LOCATION:				
ITEM NO.	DESCRIPTION OF ITEM SUBMITTED (Type, size, model number, etc.)	MANUFACTURER OR SUPPLIER	NO. OF COPIES	SPECIFICATION PARAGRAPH & PAGE NO.	DRAWING NO.	BID TEM NO.	
1							
2							
3							
4							
5							
LIST ALL VARIANCES FROM CONTRACT DOCUMENT REQUIREMENTS							
I hereby certify that all Contractor's responsibilities under the Contract Documents with respect to review and submission of the above shop drawings have been satisfied and that each shop drawing has been stamped and/or marked to indicate Contractor's compliance with the Shop Drawing review requirements. SIGNED _____ (NAME & TITLE)							

SECTION 02010
MOBILIZATION

PART 1 GENERAL

A. WORK INCLUDED

This work item constitutes all preparatory work and operations performed by the Contractor, including, but not limited to those actions necessary for the transportation and movement of personnel, equipment, supplies and incidentals to the project site; and for the establishment of all offices and other facilities necessary to work on the project. Mobilization for subcontractors and subcontracted work will be considered to be included.

Mobilization shall include the preparation of staging area(s). Drainage and erosion protection for staging areas shall be provided during construction as approved by Atlantic Richfield Company. Oil, grease, and other solid or liquid wastes shall not be disposed of in the staging area or on the project site. All solid or liquid wastes shall be disposed of off-site at a properly licensed facility. Immediately following completion of construction, the staging area(s) shall be thoroughly cleaned of all trash and debris, scarified, and revegetated.

PART 2 PRODUCTS

(Not Used)

PART 3 EXECUTION

A. REQUIREMENTS

Provide all labor, tools, equipment, materials, staging area(s), offices, facilities, and incidentals necessary to complete the work as specified.

- B.** Adequate notification (not less than 72 hours) to the property owner(s) of Contractor mobilization requirements shall be completed prior to commencement of any work, including, but not limited to, utility locates.

END OF SECTION 02010

SECTION 02110
SITE CLEARING

PART 1 GENERAL

A. CONDITIONS

Work covered by this section consists of furnishing all materials, labor, and equipment for the clearing and grubbing required to complete the work specified on the Construction Drawings, including the removal and satisfactory disposal of all trees, downed timber, brush, projecting roots, stumps, rubbish and all other objectionable material within the clearing lines approved by Atlantic Richfield Company, subject to the terms and conditions of the Contract. During clearing, grubbing and stump removal, topsoil will be protected at all times.

B. SECTION INCLUDES

1. Removal of surface debris;
2. Clearing and grubbing of trees, shrubs, and other plant life and grass in the area directly affected by the construction activities associated with this Contract; and
3. Preservation of trees and shrubs designated to remain.

C. RELATED SECTIONS

Section 02112 – Removal of Existing Structures
Section 02205 – Fill Materials and Placement
Section 02222 – Site Grading, Excavation & Embankment
Butte Hill Revegetation Specifications

PART 2 PRODUCTS

(Not Used)

PART 3 EXECUTION

A. PREPARATION

1. Contractor shall verify that existing plant life designated to remain is flagged or otherwise identified.
2. Contractor shall protect all property corners or other items from disturbance.

3. Prior to clearing, Contractor shall ascertain the limits of the structures so as not to remove any vegetation that does not require removal. This responsibility will rest solely with Contractor, and any damage caused by Contractor as a result of such negligence will be at Contractor's own risk. Contractor must confine the operation of equipment to within excavation limits, setbacks from surface water/wetland areas, easements, and approved haul roads except as otherwise approved in writing by Atlantic Richfield Company. Any damage occurring outside these areas will be repaired at Contractor's expense.

B. PROTECTION

1. Contractor shall locate, identify, and protect from damage, existing utilities, monitoring wells, or other items identified on the Construction Drawings that will remain in service during and/or after construction. Any monitoring wells, survey control points, towers, or other unique structures not shown on the Construction Drawings or specified as being removed, will be preserved, unless otherwise directed by Atlantic Richfield Company.
2. Contractor shall protect survey monuments and existing structures from damage or displacement, including all monitoring wells.

C. CLEARING

1. Contractor shall clear areas as required for access to the site and for execution of the Work as approved by Atlantic Richfield Company.
2. Contractor shall locate all stockpiles in areas approved by Atlantic Richfield Company.
3. Contractor shall remove identified trees, shrubs, stumps, roots, brush, rubbish, and other objectionable materials as designated by Atlantic Richfield Company.
4. At any time during construction, Atlantic Richfield Company may designate certain trees to be removed or retained.
5. Areas that are disturbed shall be graded, seeded, fertilized and mulched as directed by Atlantic Richfield Company.

D. REMOVAL

Disposal of all trees, branches, snags, brush, stumps, debris, etc. resulting from clearing and grubbing will be the responsibility of Contractor and will be disposed of within an Atlantic Richfield Company-designated disposal area at Contractor's expense.

END OF SECTION 02110

SECTION 02205
FILL MATERIALS AND PLACEMENT

PART 1 GENERAL

A. SECTION INCLUDES

This section specifies fill materials, identifies sources of fill materials, and specifies fill placement requirements.

B. RELATED SECTIONS

Section 02110 – Site Clearing
Section 02207 - Aggregate
Section 02222 – Site Grading, Excavation, and Embankments
Section 02245 – Lime Application
Section 02250 - Channel Construction
Section 02260 - Riprap
Butte Hill Revegetation Specifications

C. DEFINITIONS

Several types of fill materials will be utilized in the Scope of Work. Imported fill materials will include Type H - General Structural Backfill, Cover Soil, Type I and Type II – Riprap, General On-Site Fill Material, Organic Materials, and Debris. Descriptions of the fill materials and their components are as follows:

Type H – General Backfill

Type H material will be utilized as general backfill material and as structural fill for use in areas requiring structural fill. Upon placement as structural fill, Type H material will be compacted to a minimum of 95% maximum density as directed in Part 3 of this section.

Cover Soil

Cover Soil will be utilized to cover impacted areas identified on the Drawings. Cover Soil shall meet the requirements identified in the Butte Hill Revegetation Specifications.

Type I – Riprap

Type I Riprap will consist of well graded, clean, angular material as described in Section 02260 – Riprap. Type I Riprap will not contain fine materials and will have a maximum size of 12 inches.

Type II – Riprap

Type II Riprap will consist of well graded, clean, angular material as described in Section 02260- Riprap. Type II Riprap will not contain fine materials and will have a maximum size of 24 inches

General On-Site Fill Material

General On-Site Fill Material consists of all existing soil materials that may be encountered on-site. This material will be used for preliminary cut-fill operations to aide in landscaping and grading of the site. General On-Site Fill Material may not be utilized in place of Type H- General Backfill or Cover Soil.

Debris

Debris within the Project Area will be removed and disposed of at areas designated by Atlantic Richfield Company. Any wood, concrete, bricks, scrap iron, or any other debris encountered during construction will be removed and disposed of as directed by Atlantic Richfield Company.

D. REFERENCES

1. Sampling and Preparation.

- a. ASTM D75 - Standard Practice for Sampling Aggregates.
- b. ASTM D420 - Recommended Practice for Investigating and Sampling Soil and Rock.

2. Classification.

- a. USDA – USDA Methods for Soil Analysis, Agronomy Society of America, 1982
- b. ASTM D421 - Standard Practice for Dry Preparation of Soil Samples for Particle-Size Analysis and Determination of Soil Constants.

- c. Modified Day, Method 15-5 (ASA, 1986) hydrometer test for determining particle size (includes % sand, silt, and clay).
- d. Soil Survey Staff (1993), textural triangle for determining texture classification (Based on % sand, silt, and clay).
- e. ASTM D2488 - Standard Practice for Description and Identification of Soils (Visual-Manual Procedure).
- f. ASTM D4318 - Standard Test Method for Liquid Limit, Plastic Limit and Plasticity Index of Soils.
- g. AASHTO T89 – Determining the Liquid Limit of Soils
- h. AASHTO T90 – Determining the Plastic Limit and Plasticity Index of Soils

3. Density and Moisture Content: Field.

- a. ASTM D2922 - Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Wilcoxon Depth).
- b. ASTM D3017 - Test Methods for Moisture Content of Soil and Soil-Aggregate Mixtures.

4. Density and Moisture Content: Laboratory.

- a. ASTM D698 or AASHTO T99 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 5.5 lb (2.49 Kg) Rammer and 12 inch (304.8 mm) Drop.
- b. ASTM D2216 - Laboratory Determination of Water (Moisture) Content of Soil, Rock and Soil Aggregate Mixtures.
- c. ASTM D4643 - Determination of Water (Moisture) Content of Soil, Microwave Oven Method.
- d. ASTM D4718 - Standard Practice for Correction of Unit Weight and Water Content for Soils Containing Oversize Particles.

PART 2 PRODUCTS

A. SOIL MATERIALS

(Not used)

B. SOURCE QUALITY CONTROL

1. Testing and analysis of soil materials will be performed in accordance with applicable AASHTO or ASTM test methods, as listed under Part 1D of this section. Atlantic Richfield will conduct the testing and analysis of the soil materials and provide the results to the Contractor.
2. The frequency and need for testing will be determined by Atlantic Richfield Company.

PART 3 EXECUTION

A. SOURCE OF MATERIALS

1. **Type H material:** Obtain from the designated borrow areas.
2. **Cover Soil:** Obtain from the designated cover soil sources.
3. **Type I Riprap material:** Obtain from Atlantic Richfield Company approved sources. Material shall meet specifications as defined in Section 02260.
4. **Type II Riprap material:** Obtain from Atlantic Richfield Company approved sources. Material shall meet specifications as defined in Section 02260.
5. **Debris:** Potential for encountering debris in the Project Area is high. Debris shall be disposed of as directed by Atlantic Richfield Company.

B. PREPARATION FOR PLACEMENT

1. **All Imported Fill Materials:** For all areas receiving imported materials, determine boundaries from the Construction Drawings. Stake the boundaries of each area as shown on the Construction Drawings with Atlantic Richfield Company oversight. Each boundary will be field verified by Atlantic Richfield Company prior to placement of soil materials. Clear, grub and remove debris and grade areas prior to material placement. Verify that all necessary grading is completed and approved.

C. IMPORTED MATERIAL PLACEMENT

1. Type H and Cover Soil

- a. Contractor shall apply all imported materials to designated depths and quantities as shown in the Construction Drawings and these Specifications.

- b. Contractor shall include necessary grading and construction of haul roads in the work sequencing as needed. Road construction material shall consist of on site materials, unsuitable borrow materials, or Type H material as necessary.
- c. Prior to placement of imported fill materials, Contractor shall maintain surface drainage to the on site channels and Open Areas to minimize ponding of water on newly graded surfaces.
- d. Frozen soil materials shall not be utilized. Fill materials shall not be placed on ice. Material may be placed on frozen subgrade as long as the grading has been completed and approved by Atlantic Richfield Company.
- e. Contractor shall place Cover Soil in such a manner to minimize compaction. Contractor shall maintain traffic on haul roads in such a way as to minimize compaction and cross contamination in areas receiving Type H and Cover Soil materials.
- f. Contractor shall verify that Type H layer has been placed, when required, and that generally, no rocks larger than 12 inch are present. In some areas, Cover Soil will be placed on existing on-site materials, as specified on the Construction Drawings.

2. Type I and II Riprap

- a. Contractor shall apply Type I or II Riprap material in designated areas and to designated depths and quantities as stated in the Construction Drawings.
- b. Contractor shall ensure that Type I or II Riprap material does not mix with existing soil material or other backfill materials prior to placement.

3. Debris

Contractor shall distribute debris evenly throughout the debris disposal areas designated by Atlantic Richfield Company. Contractor shall fill large voids within the debris with other on-site soils or Type H material as directed by Atlantic Richfield Company.

D. COMPACTION

1. Cover Soil

- a. After placement of Cover Soil, Contractor shall scarify any material that has been compacted due to vehicular traffic by ripping, chiseling, plowing, or other methods approved by Atlantic Richfield Company. Plowing should be done as deep as possible within the cover soil without disturbing the underlying subgrade materials.

2. Type H Materials

- a. Contractor shall compact Type H material utilized as structural fill to a minimum of 95% maximum density while the material is within +/- 3% of the optimum moisture content.

3. Debris

- a. Debris material shall be compacted in debris disposal areas to minimize settlement. Debris shall be crushed and reduced in size to the extent possible prior to covering with fill. Debris placed in designated disposal areas shall be compacted to the extent possible in lifts not to exceed 24-inches thick (unless otherwise approved by Atlantic Richfield Company due to the size of the debris) to minimize future settlement of the fill.

END OF SECTION 02205

SECTION 02207
AGGREGATE MATERIALS

PART 1 GENERAL

A. SECTION INCLUDES

Aggregate materials for use as riprap, inlet and outlet construction of culverts and channels, and structural fill as shown on the Drawings.

B. RELATED SECTIONS

Section 02205 - Fill Materials and Placement
Section 02250 - Channel Construction
Section 02260 - Riprap

C. REFERENCES

None

D. SUBMITTALS

Submit material testing results for approval.

PART 2 PRODUCTS

A. AGGREGATE MATERIALS

1. Type 1 Riprap: Rock, solid, durable, and nonfriable; free of thin, slab-type rock; minimum specific gravity of 2.5 or as approved by Atlantic Richfield Company. Riprap will be angular rock only. Gradation for rock riprap will be as follows:

<u>Equivalent Spherical Diameter (feet)</u>	<u>Percent Passing</u>
1.05	100
0.88	70 - 90
0.66	40 - 60
0.27	0 - 10

2. Type 2 Riprap: Rock, solid, durable, and nonfriable; free of thin, slab-type rock; minimum specific gravity of 2.5 or as approved by Atlantic Richfield Company. Riprap will be angular rock only. Gradation for rock riprap will be as follows:

<u>Equivalent Spherical Diameter (feet)</u>	<u>Percent Passing</u>
2.00	100
1.79	70 - 90
1.32	40 - 60
0.61	0 - 10

3. Type 3 Riprap: Rock, solid, durable, and nonfriable; free of thin, slab-type rock; minimum specific gravity of 2.5 or as approved by Atlantic Richfield Company. Riprap will be angular rock only. Gradation for rock riprap shall be as follows:

<u>Equivalent Spherical Diameter (feet)</u>	<u>Percent Passing</u>
0.67	100
0.5	50
0.33	15
0.167	0

4. 6- Inch Minus: Rock, solid, durable, and nonfriable; free of thin, slab-type rock; minimum specific gravity of 2.5 or as approved by Atlantic Richfield Company. Material will be angular rock only. Gradation for rock material shall be as follows:

<u>Size (Inches)</u>	<u>Percent Passing</u>
6	100
3	80 to 95
2	70 to 80
1	30 to 40
No 200	< 10

5. Gabion Stone Fill: Rock, solid, durable, and nonfriable; free of thin, slab-type rock; minimum specific gravity of 2.5 or as approved by Atlantic Richfield Company. Gradation for gabion stone fill will be as follows:

<u>Equivalent Spherical Diameter (Inches)</u>	<u>Percent Passing</u>
9 to 11	100
7 to 9	70 to 90
5 to 7	40 to 60
2 to 4	0 to 10

6. Type E Riprap Filter Bedding (For use beneath Type 1 and Type 2 riprap): 10-inch minimum thickness of Atlantic Richfield Company-approved soil meeting the following gradation requirements:

<u>Size (Inches)</u>	<u>Percent Passing</u>
10	100
5	70 to 100
1½	44 to 62
¾	30 to 50
No. 8	18 to 40
No. 40	8 to 28

7. Type F Riprap Filter Bedding (For use beneath Type 3 riprap): 6-inch minimum thickness of Atlantic Richfield Company-approved soil meeting the following gradation requirements:

<u>Size (Inches)</u>	<u>Percent Passing</u>
4	100
1½	65 to 95
No. 4	5 to 35
No. 200	0 to 5

8. Pipe Bedding: well graded granular material meeting the following gradation requirements:

<u>Size (Inches)</u>	<u>Percent Passing</u>
1	100
No. 200	0 to 15

9. Structural Fill: well graded Type H Material obtained from on-site borrow areas meeting the following gradation requirements:

<u>Size</u>	<u>Percent Passing</u>
6"	100
3"	70 to 100
1"	50 to 90
No. 4	20 to 50
No. 40	5 to 25
No. 200	0 to 5

10. Pipestone Blend: well graded 1- inch minus material obtained from the Pipestone Quarry meeting the following gradation requirements:

<u>Size</u>	<u>Percent Passing</u>
1"	100
3/4"	90 to 100
1/2"	80 to 90
3/8"	70 to 80
No. 4	60 to 70
No. 40	15 to 25
No. 200	5 to 12

B. SOURCE QUALITY ASSURANCE

Contractor shall supply documentation to Atlantic Richfield Company verifying that materials meet requirements outlined herein.

PART 3 EXECUTION

A. STOCKPILING

1. Contractor shall stockpile materials on-site at locations designated by Atlantic Richfield Company. Stockpile areas may require stripping, as directed by the Atlantic Richfield Company.
2. Stockpile in sufficient quantities to meet project schedule and requirements.
3. Separate differing materials with dividers, or stockpile separately to prevent mixing.
4. Direct surface water away from stockpile areas to minimize erosion or deterioration of materials.
5. Manage stockpile in a manner that minimizes segregation of graded materials.

B. STOCKPILE CLEAN UP

1. Contractor shall completely remove stockpile, unless otherwise directed by Atlantic Richfield Company, and leave area in a clean and neat condition. Grade site surface to promote surface drainage and to prevent free-standing surface water.
2. Leave borrow areas in a clean and neat condition. Grade site surface to promote surface drainage and to prevent free-standing surface water.

END OF SECTION 02207

SECTION 02222
SITE GRADING, EXCAVATION AND EMBANKMENT

PART 1 GENERAL

The work of this section covers all site grading, earthwork, and embankments required for the completion of the BPSOU Source Controls Projects. The Contractor shall perform all site grading, excavation and embankment work required on the sites to the lines, dimensions, contours and elevations indicated on the drawings. This work shall include site grading, materials removal and disposal, final grading, excavation, construction of embankments, importation of borrow material, dressing and cleanup of the site as required by the drawings and specifications.

1. Classification of Excavation. All excavation shall be unclassified and shall consist of all materials encountered.

A APPLICABLE PUBLICATIONS

The publications listed below form a part of these specifications to the extent referenced. The publications are referred to in the text by the basic designation only.

1. American Association of State Highway and Transportation Officials (AASHTO).

AASHTO T-88

Particle Size Analysis of Soils

AASHTO T-180

Moisture-Density Relations of Soil Using a 10-lb.
Rammer and on 18-in. Drop

2. Montana Department of Transportation Materials Manual of Test Procedures (MDT).

MT-412

Topsoil Sampling, Sample Preparation and Testing

PART B PRODUCTS

1. Embankment Materials. All material to be used in embankment shall be approved for suitability by Atlantic Richfield Company. Material to be used in embankment shall be free of organic material, such as vegetation, roots, or peat. Rocks larger than twelve inches (12") in average dimension shall not be used in embankment unless approved by Atlantic Richfield Company. All rocks shall be dispersed throughout the embankment so that they are surrounded by fine grain material and form a dense embankment.

2. Borrow or Waste Material. The intent for earthwork is to grade slopes and contours as shown on the Drawings using on-site soils. This may result in excess material or the importation of additional material (borrow). Excess material may be incorporated elsewhere on the site or graded smooth in areas outside the embankment at locations designated by Atlantic Richfield Company.

Borrow materials, if required, will be borrowed from the areas designated by Atlantic Richfield Company in the Drawings. Borrow materials shall be inorganic clays, loams, silts, sands, and clayey or silty gravels with rocks less than twelve inches in their largest dimension. Borrow material shall be free of stones greater than 12 inches in their maximum dimensions and free of organic materials.

3. Cover soil. Cover soil will be borrowed from the areas designated by Atlantic Richfield Company in the Drawings. The cover soils will meet the specifications outlined in the Butte Hill Revegetation Specifications in Attachment A.

PART 3 EXECUTION

1. Site Preparation

1 Clearing and Grubbing. Clearing and grubbing of the site in both areas of excavation and embankment shall be done in accordance with Section 02110 – Site Clearing. Topsoil shall be stripped.

1.2 Cover soil. Cover soil shall be stripped from all areas to be excavated or to receive fill and stockpiled for potential reuse as directed by Atlantic Richfield Company. After excavations and embankments are completed, topsoil shall be spread over all disturbed areas to a minimum in place depth of 18 inches and then seeded and fertilized. The finished topsoil surface shall match grades and elevations shown on the drawings. Topsoil shall be silt, silty clay or similar material from the upper 12 inches of soil profile, or from an acceptable borrow source. Topsoil may require tilling before reseeding.

Cover soil placed over acidic subgrade soils shall be amended with limerock stabilization (Section 02245) at a rate of approximately 350 tons per acre (approximately 2 inches) and then covered with at least 18 inches of suitable cover soil.

2. Excavation

2.1 General. Excavation shall be performed to the lines, grades and elevations shown on the Contract Drawings. Atlantic Richfield Company reserves the right to make minor adjustments or revisions in lines or grades, if determined to be necessary as the work progresses to obtain satisfactory construction. The Contractor is responsible for field staking the earthwork. No excavation shall be started until the staking is complete and approved. Should the Contractor excavate below the designated limits through fault or negligence, the Contractor shall replace

such unauthorized over excavation with approved materials in an approved manner at his own expense.

2.2 Classification. All excavation shall be considered unclassified. All material encountered of whatever nature shall be removed and used in embankment or disposed of as specified in this section. The presence of rock or frozen material shall not constitute a claim by the Contractor for extra work.

2.3 Stockpiling. If at the time of excavation it is not possible to place suitable excavated material in embankment, the material shall be stockpiled in approved areas for later use.

2.4 Blasting. Blasting for excavation or other purposes will not be permitted without prior approval by Atlantic Richfield Company.

3. Embankment

3.1 Limits of Embankment. Embankment shall be placed where indicated on the plans to the lines, grades, and elevations shown on the Contract Drawings. Atlantic Richfield Company reserves the right to make minor adjustments or revisions in lines or grades, if determined to be necessary as the work progresses to obtain satisfactory results.

3.2 Scarifying. Following clearing and grubbing and immediately prior to the placing of embankment material or concrete structures and concrete ditches, the entire area underlying the embankment shall be scarified and broken by means of a disc harrow, plow or other approved equipment to a depth of six inches (6"). Scarifying shall be done approximately parallel to the longitudinal axis of the embankment. Where embankment is to be placed against an existing slope or bank, steps shall be cut into the existing slope or bank to key the new embankment into the existing slope or bank. All topsoil, roots, debris, large stones or other unsuitable material exposed by this operation shall be removed and disposed of as specified by Section 02110 - Clearing and Grubbing. Following scarification, the surface shall be recompacted to at least 95 percent of the maximum dry density per AASHTO T-180.

3.3 Placing of Material. Embankment material shall be placed in successive horizontal layers of not more than eight inches (8") in compacted depth across the full width of the cross-section. Another layer shall not be placed until the preceding layer is compacted as specified below. Layers shall be constructed approximately parallel to the finished grade line, starting in the deepest portion of the embankment. Rocks or clods larger than two inches (2") in their greatest dimension shall not be placed in the top or outside six inches (6") of the finished grade. Excessively wet material or frozen material shall not be placed in the embankment nor shall material be placed upon frozen material. Embankments shall be constructed larger than final grading such that the embankment can be cut to its final lines and contours during final grading leaving a compacted finished surface.

3.4 Compaction of Material. Embankment material shall be compacted to not less than ninety-five percent (95%) of the maximum dry density as determined by AASHTO Method T-180 in

areas where ditches, concrete structures, or embankments are to be constructed. In other areas material shall be compacted to at least ninety percent (90%) of the maximum dry density as determined by AASHTO Method T-180. Before compaction, embankment material shall be moisture-conditioned. Wetting, drying or manipulation of the material may be required to maintain a uniform moisture content throughout the cross-section. Compaction of the embankment shall extend completely across the cross-section, commencing at the sides and progressing toward the center, overlapping at each preceding passage by approximately one-half the width of the compacting equipment. The equipment, unless otherwise directed, shall operate at a speed between two (2) and three (3) miles per hour. In order to equalize compaction across the cross-section, the Contractor shall route incidental travel of both his placing and compaction equipment evenly across the embankment cross-section. Hardpan, cemented gravel, clay or other consolidated material shall be broken up before being incorporated into the embankment. Any moisture conditioning required to wet or dry embankment material shall be accomplished at no additional cost to Atlantic Richfield Company. Compaction of any trenches within any embankment shall be no less than ninety-five percent (95%) of the maximum density as determined by AASHTO T-180.

3.5 Density Testing. Field density tests of the compacted fill will run on all lifts at a frequency no less than one test per 5,000 square feet on each compacted lift. The next lift will not be started until compaction is approved on the preceding lift. The Contractor will remove any excess material above the layer to be tested. Tests will be made at locations selected by Atlantic Richfield Company. These tests will be performed by Atlantic Richfield Company. Such testing does not relieve the Contractor from his obligation of thoroughly compacting the embankment.

3.6 Drying. The embankment material may require drying prior to placement to achieve the proper moisture content. In some cases, mixing of the wet material with dryer material may be allowed to reduce moisture content in lieu of drying.

4. Tolerances

The bottom surface and slopes of embankment sections shall be of such a degree of levelness that they will not vary more than 0.15 feet above or below specified grade at any point. Channel gradeline elevations shall be within 0.15 feet of the elevations shown on the plans for channel slopes greater than 2 percent. The maximum elevation difference shall be 0.1 feet for channels with slopes of 2 percent or less. Any deviation in excess of this amount shall be corrected by the Contractor in an approved manner at no additional expense to Atlantic Richfield Company. Channel-grades cannot be changed from those shown on the drawings without Atlantic Richfield Company written approval.

5. Weather Conditions

Earthwork operation shall be suspended at any time when satisfactory results cannot be obtained on account of rain, freezing weather, or other unsatisfactory field conditions. Should the Contractor obtain a job suspension due to weather as provided in the General Conditions, then all work on all portions of the project shall cease.

6. Drainage

During earthwork operations the grade shall be maintained in such a condition that it will be well drained at all times. If necessary, temporary drains or diversion ditches shall be installed to intercept or divert surface water which could affect the work.

7. Surface and Groundwater Disposal

Any disturbed area that could allow surface water or trench dewatering water to reach a flowing stream shall meet the requirements of the project temporary erosion requirements.

8. Cleanup

Excess material will not be permitted to be accumulated and shall be removed concurrently with the finishing operation. Care will be taken to prevent the entrance of the material into drainage structures, other waterway, or storm sewers during the construction period.

END OF SECTION 02222

SECTION 02245
LIME APPLICATION

PART 1 GENERAL

A. SECTION INCLUDES

Work described in this section includes materials, methods, equipment and procedures for lime barrier layer, as appropriate, in the Butte Priority Soils Unit BMP's Phase III Design Remedial Action.

B. RELATED SECTIONS

Section 02110 – Site Clearing
Section 02205 – Fill Materials and Placement
Attachment A – Butte Hill Revegetation Specifications

C. SUBMITTALS – APPLICABLE TO AREAS REQUIRING LIME AMENDMENT

Contractor shall submit the make and model of equipment that will be used to apply a continuous lime layer to Atlantic Richfield Company for approval at least 2 weeks prior to application of the continuous lime layer.

PART 2 MATERIAL

A. LIME AMENDMENT

Unless otherwise directed or specified, lime barrier layer material shall consist of limestone that will be provided by the Contractor.

In accordance with the Butte Hill Revegetation Specifications, limestone shall have a calcium carbonate equivalent content of not less than 65%. All limestone must be <1 inch in diameter and 50% (weight basis) must pass a 60 mesh (<0.25 mm) sieve.

PART 3 EXECUTION

A. PREPARATION

Site grading, as identified on the Construction Drawings, shall be completed prior to limestone application and as defined by the Technical Specifications. Application of limestone shall commence only after the site grading has been approved by Atlantic Richfield Company or its representative.

B. LIME STOCKPILE MANAGEMENT AND HANDLING

Contractor shall supply an Operation Plan for stockpile management and handling of limestone material during all phases of the project (stockpile management, hauling, loading). The Operation Plan shall include the proposed procedure for distributing limestone to treatment areas, maintaining the quality of limestone during all limestone handling activities, and protecting personnel and the public from limestone exposure. Contractor shall submit the Operations Plan to Atlantic Richfield Company and receive approval of the plan prior to commencement of placement activities. The Operations Plan shall address the following guidelines:

1. Existing stockpiles shall be maintained such that limestone material is not degraded in any way.
2. Temporary limestone stockpiles shall be worked in a manner that maintains the quality and effective quantity of the limestone material. When a temporary limestone stockpile is no longer needed, all usable limestone within the stockpile shall be removed and used for lime treatment elsewhere and the remaining stockpile area graded level with existing ground.

C. LIMESTONE APPLICATION

The limestone application rate shall be sufficient to obtain a minimum of 350 tons/acre (approximately 2-inch thick continuous layer) over the identified area of low pH soil. Application of limestone material shall be performed in accordance with the Construction Drawings and the Butte Hill Revegetation Specifications:

1. Contractor shall demonstrate that the limestone spreader is calibrated to achieve the desired thickness of limestone across the treatment area with a tolerance of + ¼ inch of the target 2 inch thickness. An Atlantic Richfield Company representative will measure the thickness of the limestone being spread by the Contractor. Contractor shall make adjustments to the limestone spreader until the desired limestone layer thickness is being applied within the specified tolerances. Contractor shall comply with random checks, at the discretion of an Atlantic Richfield Company representative, if the application rate becomes inconsistent or non-uniform, additional limestone shall be applied at no additional cost to Atlantic Richfield Company.
2. If winds exceed 10 miles per hour (mph), or are sufficiently strong to move the lime material off the project area during spreading, application shall cease until winds subside sufficiently to continue the work.
3. Limestone shall not be applied in areas of standing water. These areas shall be dewatered and inspected by Atlantic Richfield Company or its representative prior to performing lime application in these areas.

4. Contractor shall apply 100% of the limestone material in a uniform layer across the surface being treated. Each adjacent pass of the spreader shall be adequately overlapped to provide uniform application across the treatment area. Proper overlap in limestone application may be tested.
5. Applied limestone layer shall be immediately covered with cover soil. The cover soil will be applied over the limestone layer in a manner not to disturb the continuous limestone layer. All limestone shall be covered with cover soil prior to leaving the site for the day.

END OF SECTION 02245

SECTION 02250

CHANNEL CONSTRUCTION

1.0 GENERAL

The work of this section covers all grass, riprap, rock, and concrete lined channel construction. The Contractor shall perform all site grading, excavation, and embankment needed to shape and construct the channels and provide and install all materials required to line the channels. All channels shall be constructed to the lines, dimensions, and elevations shown on the drawings.

2.0 APPLICABLE PUBLICATIONS

The publications listed below form a part of these specifications to the extent referenced. The publications are referred to in the text by the basic designation only.

ASTM D698 or AASHTO T99 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 5.5 lb (2.49 Kg) Rammer and 12 inch (304.8 mm) Drop.

3.0 MATERIALS

3.1 Geotextiles

Geotextiles shall be as specified in Section: 02270 - Geotextiles

3.2 Riprap

Riprap shall be as specified in Section: 02260 – Riprap. Riprap shall be Type I, Type II, or Type III as designated on the drawings.

3.3 Rock

Rock materials shall be as specified in Section 02207 – Aggregate Materials

3.4 Filter Bedding Materials

Filter Bedding Materials shall be as specified in Section: 02207 – Aggregate Materials. Filter Bedding Materials shall be Type E or Type F and utilized accordingly for Type I, II and III riprap as outlined in Section 02207 – Aggregate Materials.

4.0 CONSTRUCTION

4.1 General

All channels shall be constructed to the lines, grades, elevations, and sections as shown on the drawings. Grades shall be true and uniform between designated elevation points. Channel subgrades shall be carefully cut to match the required sections. The subgrade for concrete channels shall be compacted to 95% maximum proctor (AASHTO T-180 Method-D/ASTM - 1557 Method-D).

4.1 Grass-Lined Channels

After the channel has been cut to the proper line and grade, the channel shall be broadcast seeded with the seed mixture as outlined in the Butte Hill Revegetation Specifications.

Geotextile composite turf reinforcement mat (C-TRM) meeting the requirements of Section-02270, Part 3.2 shall be placed and pinned to the surfaces of the channel after the seeding operations as shown on the drawings.

Seeding operations shall not be conducted between the six-month period of May 15- October 15. Seeding operations shall not be conducted on frozen ground. Contractor shall schedule his construction activities to minimize the amount of time between channel shaping work and seeding/C-TRM installation work. Erosional damage to the channel after channel shaping work shall be repaired by the Contractor, at no additional cost to Atlantic Richfield.

4.2 Riprap Lined Channels

After the subgrade has been cut to the proper line and grade, filter bedding materials shall be placed and compacted on the surfaces of the channel to be covered by riprap. The filter bed materials shall be compacted to minimum of 90 percent of the maximum dry density as determined by AASHTO T99/ASTM 698 or as directed by Atlantic Richfield Company representative. Riprap shall be of the class called for on the drawings. Type I riprap shall be placed to a finished thickness of 1.5 feet. Type II riprap shall be placed to a finished thickness of 3.0 feet. Type III riprap shall be placed to a finished thickness of 1.0 feet. Riprap shall be carefully placed on the filter bedding materials utilizing a backhoe, loader or similar machine in such a manner that the filter bedding materials will not be displaced. If the filter bedding materials are displaced or the geotextile is damaged, the riprap shall be removed, and the filter bedding materials repaired and re-compacted.

4.3 Rock Lined Channels

After the subgrade has been cut to the proper line and grade and the subgrade has been compacted to a minimum of 90 percent of the maximum dry density as determined by AASHTO T99/ASTM 698. Rock material shall be of the type called for on the drawings and the section shall be placed to a finished thickness of 1.0 feet and shall be compacted to a minimum of 90 percent of the maximum dry density as determined by AASHTO T99/ASTM 698 or as directed by Atlantic Richfield Company representative.

4.3 Grouted Riprap Lined Channels

See Section 02260 Riprap, for grouted riprap materials and installation instructions.

5.0 TOLERANCES

Channels shall be constructed to +/- 0.10 feet of the final grades as shown on the PAD Drawings.

END OF SECTION 02250

SECTION 02260
RIPRAP

1.0 GENERAL

The work in this section covers all riprap material placement required for this project. The Contractor shall provide and place riprap at the locations and to the dimensions as shown on the drawings.

2.0 RELATED SECTIONS

Section 02205 - Fill Materials and Placement
Section 02250 - Channel Construction
Section 02207 – Aggregate Materials

3.0 REFERENCES

The publications listed below form a part of these specifications to the extent referenced. The publications are referred to in the text by the basic designation only.

3.1 American Society of Testing and Materials (ASTM)D-4992
Evaluation of Rock to be Used for Erosion Control

3.2 Montana Department of Transportation Standard Specifications – Road and Bridge
Construction 1995
Section 701.06- Riprap
Section 701.07 - Bank Protection

3.3 American Association of State Highway Transportation Officials (AASHTO)
T104-94 Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate

4.0 MATERIALS

4.1 Riprap

Furnish stone that is hard, durable, angular in shape, resistant to weathering and to water action, free from overburden, spoils, thin slab-type shale rock, structural defects, and organic material and shall meet the appropriate gradation for random riprap. Source and gradation shall be submitted to Atlantic Richfield Company for approval 7 days prior to placement. Riprap shall conform to the following gradations listed in Table 2260-1.

TABLE 2260-1: RIPRAP GRADATIONS

Type	Weight of Stone	Equivalent Spherical Diameter *	Percent Passing
I	100 lb (45 kg)	1.05 ft (320 mm)	100
	60 lb (27 kg)	0.88 ft (270 mm)	70 – 90
	25 lb (11 kg)	0.66 ft (200 mm)	40 – 60
	2 lb (0.9 kg)	0.27 ft (80 mm)	0 – 10
II	700 lb (318 kg)	2.00 ft (610 mm)	100
	500 lb (227 kg)	1.79 ft (545 mm)	70 – 90
	200 lb (91 kg)	1.32 ft (400 mm)	40 – 60
	20 lb (9.0 kg)	0.61 ft (190mm)	0 – 10
III	26 lb (12 kg)	0.67 ft (204 mm)	100
	11 lb (5 kg)	0.50 ft (152 mm)	50
	3 lb (1.4 kg)	0.33 ft (101 mm)	15
	0.5 lb(0.2 kg)	0.167 ft (51 mm)	0

* Based on unit weight of 165 lb/ft³ (2675 kg/m³)

Additional Requirements

All Channel Lining Riprap shall conform to:

- Specific Gravity Requirements – Specific Gravity is a measure of the rock density (ASTM C127). The rock surface shall have a bulk specific gravity (saturated, surface dry) of 2.5 or greater.
- Absorption Requirements – Absorption is a measure of rock porosity (ASTM C127). The rock shall have an absorption value of 2 percent or lower.
- Los Angeles Abrasion Requirements – The Los Angeles Abrasion test is an indicator of hardness and structural soundness (ASTM C535). The rock shall have a test value of 35 percent or less for 500 revolutions.
- Sodium Sulfate Soundness Requirements – Sodium Sulfate Soundness test is an indicator of durability against disintegration (AASHTO T104-94). The rock shall have a test value of 12 percent loss or less for five cycles.
- Bedding: Where specified on the Drawings, aggregate bedding material shall be Type E or Type F riprap filter bedding material as specified in Section 02207 – Aggregate Materials. In-place native subsoils may be used as bedding if they meet the requirements of Section 02207.
- Grout: Cement grout shall conform to American Concrete Institute requirements and meet the following:
 - Strength: 2,000 – 2500 pounds per square inch (psi);
 - Cement shall be Type V or equivalent see Section 03310 Structural Concrete
 - Aggregate: American Society for Testing and Materials (ASTM) C-33 FINE AGGREGATE with a maximum aggregate size of ¾ inch;
 - Slump: 4 to 6 inches; and
 - Air Entrainment: 5 to 7%.

All Cover Rip Rap shall conform to:

- Specific Gravity Requirements – Specific Gravity is a measure of the rock density (ASTM C127). The rock surface shall have a bulk specific gravity (saturated, surface dry) of 2.4 or greater.
- Absorption Requirements – Absorption is a measure of rock porosity (ASTM C127). The rock shall have an absorption value of 3 percent or lower.
- Los Angeles Abrasion Requirements – The Los Angeles Abrasion test is an indicator of hardness and structural soundness (ASTM C535). The rock shall have a test value of 40 percent or less for 500 revolutions.
- Sodium Sulfate Soundness Requirements – Sodium Sulfate Soundness test is an indicator of durability against disintegration (AASHTO T104-94). The rock shall have a test value of 15 percent loss or less for five cycles.

5.0 EXECUTION

5.1 Placement

1. Subgrade for riprap or grouted riprap shall be compacted in accordance with Section 02205 - Fill Materials. Areas of fill within the ditch section shall be compacted in accordance with the requirements for Structural Fill as specified in Section 02205.
2. Riprap material shall not be placed until the surface has been prepared and approved. Riprap shall be placed on subgrade (or bedding material where soft, wet areas are encountered) as shown on the Drawings. The material shall conform to the cross-sections and profiles shown on the Drawings. The stone shall be carefully handled and dumped to avoid material segregation and damage to the underlying bedding or geotextile. The rock shall be sufficiently manipulated by hand or machine methods to secure a regular surface and mass stability. Where the thickness of the riprap is not shown on the Drawings, it shall be at least 15 inches measured perpendicular to the slope.

When riprap is specified for placement around pipe openings, special care shall be taken when placing and handling. Manipulation of individual rocks during placement of riprap shall be required as determined by Atlantic Richfield Company. Any damage to pipe or structures shall be repaired or replaced at no expense to Atlantic Richfield Company.

3. For grouted rock linings, grout must penetrate a minimum of 8 inches into the rock.

5.2 GROUTED RIPRAP CURING AND PROTECTION

Thoroughly protect concrete surfaces subject to premature drying by covering as soon as possible with canvas, plastic sheets with sealed joints, burlap and sand or other satisfactory materials and keep concrete moist. If the concrete surfaces are not covered, keep them moist by flushing or sprinkling. Continue curing for at least 7 days after placing the concrete.

The curing of concrete, by either water curing or membrane curing, must be as follows unless otherwise approved by the Engineer.

5.2.1 Water Curing

Keep all concrete top surfaces continuously moist after finishing, with a fine water spray, until the concrete has set. Cover the moist concrete with water or an approved curing covering.

- a.** Cure grouted rock linings for at least 7 days. Cure by placing burlap, cotton mats or other absorptive material as close behind the finishing operation as possible without marring the finished surface. Keep the absorptive material continuously moist for the full time it is used.

5.2.2 Impervious Membrane Curing

Assure membrane curing compounds are delivered to the job in the manufacturer's original container, clearly labeled to show the name of the manufacturer and the contents. Curing compounds shall be approved by the Engineer prior to use. The clear curing compound must be sufficiently transparent and free from permanent color that would change the color of the natural concrete. Use clear compound containing a fugitive dye having color sufficient to render the film visible on the concrete for at least 4 hours after application. The concrete surface must maintain its natural color after curing.

- a.** Use a compound ready for use as shipped by the manufacturer. Dilute following the manufacturer's recommendations. Use curing compound only with written approval. Sampling will not be required if manufacturer's certification is available. Apply the curing compound under pressure with a spray nozzle to cover the entire exposed surface thoroughly and completely with a uniform film not exceeding manufacturer's specifications. Maintain the required pressure in the spray machine to force the material to leave the nozzle in a fine mist. Keep all concrete surfaces moist with a fine water spray or with wetted burlap until the sealing compound is applied. Seal the concrete immediately after the finishing operations have been completed, to the satisfaction of the Engineer.
- b.** If it is necessary to allow workers or equipment on the surface before the 7 day curing period is completed, cover the top surface of sealed concrete with a protective cushion for runways. Use a cushion consisting of a moist, 1-inch (25 mm) minimum thick layer of fine sand, or layers of moist burlap that will prevent damage to the finished concrete. Cover the approved cushion with four by eight foot sheets of 3/4 inch(19 mm) plywood laid over the cushion. Do not place the cushion material for at least 8 hours after the final application of the curing compound. Obtain the Engineer written approval for any other proposed cushion material before use. Layers of plastic, visqueen or canvas are not an acceptable cushion material.

5.3 WEATHER AND NIGHT LIMITATIONS

5.3.1 General

Stop grouting operations when darkness prevents obtaining the specified placing and finishing work. Night operations may be conducted with written approval and when approved artificial lighting is provided.

Cold weather concreting is governed by ACI 306 unless otherwise specified herein. Hot weather concreting methods is governed by ACI 305 unless otherwise specified herein. Except by specific written authorization, stop concreting operations when a descending air temperature in the shade and away from artificial heat falls below 40°F (4°C), or do not resume until an ascending air temperature in the shade and away from artificial heat reaches frozen foundation course or subgrade.

Assume all risk of placing concrete in cold weather. Placing concrete during cold weather does not relieve the Contractor of the responsibility for obtaining the specified results. Remove and replace all concrete injured by frost at Contractor expense.

Before any concrete is placed, remove all ice, snow and frost completely from the riprap receiving the concrete.

5.3.2 Protection of Concrete

During the curing period, if the air temperature is anticipated to fall below 32°F (0°C), provide an approved blanket type insulating material along the work for covering all concrete that has been in place for 7 days or less. If, at any time, the ambient temperature drops to 32°F (0°C) or less, protect the concrete using a method approved by the Engineer. The minimum method of protection under such conditions is as follows:

Between two layers of plastic sheeting, the insulating materials, with the exception of commercial blankets, must be spread loosely to a minimum depth of 6 inches (150 mm), but in all cases, to the depth required to prevent freezing of, or frost damage to, the concrete. Maintain the blanketing material at least until the end of the regular specified curing period which is not less than 7 days. The Engineer may direct leaving the blanketing material in place for an additional period if the recorded temperatures indicate that additional curing may be necessary. If during the construction period the mean daily temperature is expected to fall below 40°F(4°C) for 3 consecutive days, furnish approved heating enclosures and devices capable of maintaining the surface temperature of the concrete in place between 55°F(13°C) and 80°F(26°C). The curing period under these conditions is 7 days. At the close of the curing period, the heat may be reduced so that the temperature inside the housing does not decrease faster than 15 degrees F per hour until the temperature inside the housing is the same as outside.

The Contractor may, at his own expense, field cure concrete cylinders with their in-place concrete and discontinue protection when those field cylinders reach 70 percent of design strength as indicated by the 28 day strength requirement of these specifications.

Perform all concrete protection using methods consistent with ACI-306-1-87 and approved by the Engineer.

END OF SECTION 02260

SECTION 02515 **BASECOURSE**

PART 1 - GENERAL

1.01 WORK INCLUDED

The work covered under this section consists of furnishing all materials, crushing if necessary, loading, hauling, spreading, shaping, watering, compacting, labor, tools, equipment and incidentals for the construction of basecourse to the lines, grades, and dimensions shown on the Drawings and placed in accordance with the specifications.

1.02 DEFINITIONS

Base course is defined as an untreated crushed or screened natural gravel aggregate material from an approved borrow source that is placed on a prepared subgrade.

1.03 REFERENCES

- | | | |
|----|-------------|---|
| A. | ASTM D 75 | Standard Practice for Sampling Aggregates. |
| B. | ASTM D 420 | Recommended Practice for Investigating and Sampling Soil and Rock. |
| C. | ASTM D 421 | Standard Practice for Dry Preparation of Soil Samples for Particle-Size Analyses and Determination of Soil Constants. |
| D. | ASTM D 422 | Standard Method for Particle Size Analysis of Soils. |
| E. | ASTM D 698 | Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using a 5-lb Rammer and 12-inch Drop. |
| F. | ASTM D 2216 | Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil Aggregate Mixtures. |

G.	ASTM D 2487	Classification of Soils for Engineering Purposes.
H.	ASTM D 2922	Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
I.	ASTM D 3017	Moisture Content of Soil and Soil-Aggregate In-Place by Nuclear Methods (Shallow Depth).
I.	ASTM D 4318	Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
J.	ASTM D 4718	Standard Practice for Correction of Unit Weight and Water Content for Soils Containing Oversize Particles.
K.	ASTM C 136	Sieve Analysis of Fine and Coarse Aggregate.
L.	MT-209	Percentage of Wear by Los Angeles Abrasion

1.04 SUBMITTALS

- A. Test Reports: The Contractor shall test materials and submit one copy of the following results to the Engineer:
1. All field density test reports and laboratory compaction curves.
 2. All sieve analyses (gradation) and Atterberg limits analyses performed.
 3. A complete set of aggregate quality tests as required by the Specifications.

1.05 PRODUCT HANDLING

- A. A sufficient number of haul vehicles shall be utilized to assure a continuous operation with consideration given to distance of haul, traffic conditions, and production rates at the project site.
- B. Delivery shall be made with the least possible impedance to normal flow of traffic and, when necessary, the Contractor shall supply flagmen and/or traffic control devices consistent with state law and the Manual on Uniform Traffic Control Devices (MUTCD), latest edition and the requirements of these specifications.

PART 2 - PRODUCTS

2.01 GENERAL

Aggregate shall be crushed stone consisting of hard, durable particles or fragments of stone, free of flat, elongated, soft, or disintegrating pieces, dirt, or other deleterious matter, and having a percentage of wear not exceeding 50 at 500 revolutions, when tested under AASHTO T-96 (Los Angeles Abrasion Test). In addition, the aggregate shall be free of vegetable matter, clay balls, frozen lumps, or other extraneous or deleterious matter and shall conform to the gradation specification presented below. The liquid limit for the aggregate passing the No. 40 screen must be non-plastic when tested in accordance with ASTM Test Method D-4318.

Aggregate material shall be furnished by the Contractor and the gradation shall meet the requirements of the gradations listed in Table 02515-1.

**TABLE 02515-1
BASE COURSE
GRADATION SPECIFICATIONS**

AGGREGATE GRADATION CHART	
SIEVE DESIGNATION (SQUARE OPENINGS)	PERCENTAGE BY WEIGHT PASSING THROUGH SIEVES
1 1/2"	100
No. 4	25-60
No. 200	2-8

PART 3 - EXECUTION

3.01 SURFACE PREPARATION

No surface material shall be placed upon a frozen, muddy, yielding, or rutted subgrade or gravel surface. Material shall be deposited in a uniform manner approved by the PRP Representative to insure the required plan thickness of the basecourse following spreading and compaction.

Before placing the basecourse, blade smooth and shape the surface of the underlying subgrade to the cross section shown on the Drawings prior to placing the basecourse. Check compaction of the subgrade as required in these specifications.

3.02 PLACEMENT AND SPREADING

- A. Mix and place the material in uniform lifts with a maximum 8-inch loose thickness unless otherwise approved. Deposit and spread the material on the prepared subgrade, or on a completed subgrade and progress continuously without interruption. Discontinue operating haul units over the subgrade if the haul units damage the subgrade. Deposit and spread the material in a uniform layer, without segregation, to the loose depth that when compacted, the layer has the specified thickness. Spread the material to distribute the material in a uniform layer. The material may be deposited in windrows mixed and spread as described below. Construct each layer meeting these requirements. Blade smooth and thoroughly compact each layer as specified before placing the succeeding layer.
- B. If segregation, moisture or compaction problems exist, or if the material was placed on the road in windrows, thoroughly blade-mix the material to each layer's full depth by alternately blading the layer to the center and back to the edges of the street.
- C. Add water before and during the mixing operations when required in the quantity necessary to prevent segregation of fine and coarse materials. Use a sprinkler or other water spreading device that provides a uniform water distribution without causing a washing effect of the base material. Obtain approval from the PRP Representative before use.

3.03 COMPACTION

- A. Subgrade shall be scarified and compacted to a depth of 12-inches prior to placement of basecourse. The subgrade and the basecourse shall be compacted to 95% of a standard proctor (ASTM D 698) at plus or minus 2 percent of optimum moisture content.
- B. Compact the material the full width by rolling with suitable tamping equipment or smooth drum power rollers. Correct all irregularities or depressions that develop during rolling by loosening the material in these places and adding or removing material as required.
- C. Perform blading and compacting alternately as required or directed, to maintain a smooth, even, uniformly compacted surface until the final inspection. At all places not accessible to the roller, compact the basecourse with suitable mechanical tampers or hand tampers to reach compaction requirements.

- D. Provide the watering and rolling required to obtain a minimum field density of 95 percent of the maximum dry unit weight as obtained by ASTM Test Method D 698. No separate compensation will be made for rolling and watering the basecourse.

3.04 RESTRICTIONS

In addition to the restrictions imposed by Federal, State, County, and City law on hauling vehicles, the Contractor shall restrict the speed of the hauling units and the weight of loads as he deems necessary to prevent damage to public thoroughfares used.

3.05 SURFACE SMOOTHNESS

- A. The surface of any base course when finished and tested with a 10-foot template placed on the surface with its centerline parallel to the centerline of the road shall not have a surface deviation from the straight edge exceeding 1/2-inch. Additionally, the finished grade cannot deviate more than 0.1 feet at any point from the staked elevation, and further, the sum of the deviations from two points not more than 30 feet apart cannot exceed 0.1 feet.
- B. If patching of the base course is necessary to meet the tolerances, perform patching using methods and aggregates approved by the PRP Representative. No compensation for patching will be provided.

3.06 QUALITY CONTROL/QUALITY ASSURANCE

The Contractor shall provide quality control soil testing and inspection service during construction to assure compliance with the Drawings and Specifications. All such quality control shall be at the expense of, and under the direction of, the Contractor. The Contractor shall be responsible for scheduling all such testing and for repair and retesting of all deficient areas. Quality Assurance testing shall be performed by the PRP Representative.

Quality Assurance testing will be provided by the PRP Representative at a frequency to be determined by the Engineer. If quality assurance testing discovers material placements which do not satisfy the requirements of the Drawings and Specifications, all costs and expenses associated with said testing will be charged to the Contractor and the repair of all deficiencies shall be at the expense of the Contractor.

- A. Contractor Quality Control Testing and Inspection
 - 1. Subgrade and Base Course Compaction Control.

Perform quality control field density tests in accordance with ASTM D 2922 and ASTM D 3017 for the subgrade and base course at a minimum frequency of two compaction tests for the following: every 500 lineal feet of 8 foot wide trail or every 4000 square feet of surface area covered or every 100 cubic yards placed, whichever is less. Perform laboratory "Proctor" tests for the base course aggregate for each change in gradation within the specified envelope.

If, in the opinion of the Engineer, or based upon testing service reports and inspection, subgrade or basecourse aggregate has been placed below the specified density, the Contractor shall repair or replace the deficient materials, provide additional compaction, and retest the soil compaction at no additional cost to the PRP's.

2. Gradation Control

The Contractor shall verify the soil gradation satisfies the gradation requirements of the Specifications. One gradation shall be submitted for every 4,000 cubic yards of placed and compacted material. Materials which do not satisfy the gradation requirements of the Specifications shall be removed and replaced with acceptable materials at no expense to the PRP's.

3. Aggregate Quality

Base course aggregate shall be from an approved existing gravel pit or a new gravel pit if it can be demonstrated by submission of applicable test results that the aggregate satisfies the quality requirements set forth in the Specifications. Previous test results from existing gravel pits will be acceptable provided they are applicable to the portion of the pit that will be used to produce the aggregate. If the pit is new, or if a new area of the gravel pit will be opened to produce the aggregate, a complete set of aggregate suitability tests will be required prior to use on the site.

3.07 PROTECTION

- A. Hauling equipment may be routed over completed portions of the basecourse, provided no damage results and provided that such equipment is routed over the full width of the basecourse to avoid rutting or uneven compaction. If the Contractor is negligent in monitoring hauling operations and creates yielding, rutting or uneven compaction, the PRP Representative may stop all hauling over completed or partially completed basecourse when, in his opinion, such hauling is causing damage. Any damage resulting

to subgrade or basecourse courses from equipment shall be repaired by the Contractor at his own expense.

3.08 MAINTENANCE

- A. The Contractor shall perform all maintenance work necessary to keep the basecourse course in a condition satisfactory for placement of subsequent lifts, if required. The surface shall be kept clean and free from foreign material. The basecourse course shall be properly drained at all times. If cleaning is necessary, or if the graded surface becomes disturbed, any work or restoration necessary shall be performed at the expense of the Contractor.

END OF SECTION 02515

SECTION 02751
CULVERTS AND PIPING

PART 1 GENERAL

A. SECTION INCLUDES

The work covered in this section shall consist of furnishing, placing and constructing culverts and piping in accordance with the drawings and specifications.

B. RELATED SECTIONS

Section 02222 – Excavation
Section 02207 – Aggregate Materials

C. REFERENCES

The publications listed below form a part of these specifications to the extent referenced. The publications are referred to in the text by the basic designation only.

American Association of State Highway and Transportation Officials.

AASHTO M-36	Corrugated Steel Pipe, Metallic coated for sewers and drains.
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AASHTO M-55	Steel Welded Wire, Fabric, Plain for Concrete Reinforcement.
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AASHTO M-170	Reinforced Concrete Culvert Metal Culvert Pipe and Pipe Arches.
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Montana Department of Transportation Standard Specifications for Road & Bridge Construction.

Sec. 603	Culverts, Storm Drains, Sanitary Sewers, Stockpasses and Underpasses
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Sec. 708	Concrete, Plastic and Fiber Pipe
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Sec. 709	Metal Pipe
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PART 2 PRODUCTS

A. MATERIALS

1. **General.** Culverts and appurtenances furnished under this contract shall be as called out in the proposal and/or plans and shall be in accordance with materials

and testing as specified. Pipe strength classifications shall be as shown on the plans and/or as listed in the Proposal. All pipe shall be as clearly marked with type, class and/or thickness as applicable. Lettering shall be legible and permanent under normal conditions of handling and storage.

2. **Certification by Manufacturer.** Prior to installation the Contractor shall furnish certification by the manufacturer of the pipe to be furnished on this project, certifying that the pipe and fittings comply with the applicable specifications.
3. **Reinforced Concrete Pipe.** Reinforced concrete pipe shall be Class 3 pipe, unless otherwise specified on the drawings, and shall conform to Montana Department of Transportation Standard Specifications 708.01.1, 708.01.2, 708.01.5 and AASHTO M-55 and M-170. Internal diameters are shown on the drawings. The pipe shall be furnished in laying lengths of four feet or longer. Flared end sections shall be furnished as shown on the drawings. Pipe coating shall be factory applied culvert mastic No. 351-A, water base coating, Pure Asphalt Corp., Chicago or low pH resistant coating as recommended by the manufacturer.
4. **Bituminous-Coated Corrugated Steel Pipe.** Shall conform to Montana Department of Transportation Standard Specifications 709.02 and 709.04 and AASHTO M-36 and M-190. The pipe sections shall be provided in lengths necessary to construct the installations as shown on the drawings. The steel pipe shall have minimum 16 gauge thickness for pipes smaller than 36 inches in diameter and a minimum 12 gauge thickness for pipes of 36-inch diameter or greater. Corrugations furnished shall be 2 2/3 inches x 1/2 inch. Flared end sections shall be furnished as shown on the Drawings.
5. **Corrugated High Density Polyethylene Pipe.** Corrugated high density polyethylene pipe and fittings shall meet the requirements of AASHTO M252 and M294 and ASTM F2306. The pipe and fittings shall be Advanced Drainage System dual wall pipe or approved equal. Pipe shall be furnished in the manufacturer's standard length with watertight joints and/or couplings as recommended by the manufacturer. Fittings shall likewise be of the manufacturer's recommended type for the pipe and shall be constructed of like material to the pipe. Contractor shall determine fittings necessary to install pipe at alignments shown on the Drawings.
6. **High Density Polyethylene Pipe (HDPE)** pipe shall be manufactured from pressure rated black polyethylene compound material that meets or exceeds ASTM D 3350 Cell Classification 445474C and in accordance with the requirements of AWWA C906 and ASTM D 3035 Standards, latest edition. HDPE pipe shall be of the size and pressure rating as shown on the Drawings. HDPE fittings shall be manufactured from pressure rated black polyethylene compound material that meets or exceeds ASTM D 3350 Cell Classification 445474C and in accordance with the requirements of AWWA C906, and ASTM

D1248/D2513/ D3035/D3261 Standards, latest edition. Fittings shall have connections as specified for on the Drawings.

7. **Polyvinyl Chloride (PVC) Pipe.** PVC Pipe needs to meet ASTM Designation D-1784 requirements and should be produced by a continuous extrusion process. The PVC pipe must meet one of the following requirements: ASTM D-3034 or ASTM F679. The PVC pipe should be highly resistant to hydrogen sulfide, sulfuric acid, gasoline, oil, detergents and other chemicals found in sewage and industrial waste.

PVC pipe must have nominal laying lengths of 12.5 feet, except shorter lengths may be used adjacent to manholes or similar. Assure each pipe section is marked, as a minimum with size, SDR, "Sewer Pipe" and Code Number.

Each pipe length will have a bell designed to provide a water tight joint when jointing the bell and spigot with a rubber ring. Each joint will have a rubber gasket compressed between the outer surface of the spigot and the inner surface of the bell. Assure the joint is completely sealed by the gasket so that the assembly remains watertight under all service conditions, including expansion, contraction, settlement and pipe deformation. Follow manufacturer's recommendations when assembling the rubber joint. Assure wye or tee fittings for connecting service lines are of the same material, construction and joint design as the main PVC line.

PART 3 EXECUTION

A. GENERAL

1. Excavate to permit installation, jointing and backfilling of pipe.
2. Construct and maintain the excavations to prevent personal injuries, damage to foundations, structures, pole lines, or other facilities. Pile and maintain all excavated material to meet O.S.H.A. requirements and with a minimum of inconvenience to the public.
3. Do not excavate below the specified depth, except as when directed by Atlantic Richfield Company.
4. Remove all obstructions in the excavation at Contractor expense.
5. Backfill excavated areas to meet Section 02225. Remove all sheeting and bracing before backfilling.

B. FOUNDATION PREPARATION

1. Compact foundations for culverts to the moisture and density requirements of

Section 02222.

2. Pipe shall be carefully bedded in suitable material. Pipe bedding shall meet the requirements of Section 02207. Pipe bedding shall extend from 6 inches below to 6 inches above the pipe. The prepared foundation shall be shaped to conform to the lower quadrant of the pipe. Bell or coupling holes shall be carefully formed so as to not destroy more than nine inches of pipe bearing. Heavy compaction equipment shall not be utilized until the backfill is at least 12 inches above the pipe. Small plate tampers, pneumatic, or hand tampers shall be utilized around the pipe and to a depth of 12 inches over the pipe.
3. Remove unstable or unsuitable material encountered below the excavation elevation and replace with material meeting Section 02222. Remove yielding material below the staked elevation to at least 12-inches and replace with suitable material meeting Section 02222.
4. Do not lay pipe until the foundations are approved by Atlantic Richfield Company. Remove and relay pipe laid on unapproved foundations at Contractor's expense.
5. Perforated pipe shall be carefully bedded on drain rock as shown on the Drawings.

C. RESPONSIBILITY FOR MATERIAL

1. Contractor shall be responsible for all material furnished by him and shall replace at his own expense all such material found to be defective or damaged in handling after delivery by the manufacturer. This shall include the furnishing of all materials and labor required for the replacement of installed material discovered to be damaged or defective prior to the final acceptance of the work, or during the guarantee period.
2. Contractor shall be responsible for the safe and proper storage of material used in the project. The interior of all pipe and other accessories shall be kept free from dirt and foreign matter at all times.

D. HANDLING OF PIPE

1. All pipe shall be delivered and distributed at the site by the Contractor. Pipe, fittings, specials, and accessories shall be loaded and unloaded in a manner to avoid shock or damage. Under no circumstances shall such materials be dropped. Pipe shall not be skidded or rolled against pipe already on the ground. Pipe shall be handled in a manner to prevent damage to the coating and lining. Pipe which is damaged shall be rejected.

E. LAYING PIPE

1. Pipe shall be protected in handling to prevent damage. The pipe shall be inspected before lowering into the trench and any concrete pipe sections which are cracked (will not give a clear ringing sound when lightly tapped with a hammer) or which have been chipped or otherwise damaged to such extent that good sound joints, to the full depth of the bell socket cannot be made, will be rejected. Rejected pipe shall be removed from the site immediately. The pipe shall be of the size shown on the drawings.
2. All pipe shall be laid true to line and grade. All pipe shall be laid to +/- 0.03 feet of the final grade as shown on the PAD Drawings
3. Wherever obstructions not shown on the plans are encountered during the progress of the work and interfere to such an extent that an alteration in the plan is required, the Atlantic Richfield Company's Representative shall have the authority to change the plans and order a deviation from the line and grade or arrange with the owners of the structures for the removal, relocation and reconstruction of the obstructions.

F. TESTS

1. **Light Test.** After the trench has been backfilled, a light test shall be made between the ends of the pipe to check for alignment and grade for displacement of pipe. The completed pipeline shall be such that a true circle of light can be seen from one end of the culvert to the other end. If alignment or grade is other than specified and displacement of pipe is found, the Contractor shall remedy such defects at his own expense.

END OF SECTION 02751

SECTION 05500

TRAFFIC CONTROL

A. GENERAL

1. **DESCRIPTION** - Traffic control shall consist of furnishing, installing, maintaining, and relocating necessary traffic signs, barricades, lights, signals, pavement markings, and other traffic control devices necessary to insure the safety of the general public and project personnel. This work shall include flagging for the guidance of traffic through the work zone(s) and furnishing and application of water for dust control.
2. **OPERATIONS** - The Contractor shall conduct his operations so that there is a minimum interruption in the use of the roads and highways involved at all times.

The Contractor shall schedule his operations to keep all roads and streets open to a minimum of one-way traffic during normal working hours during construction. Two-way traffic shall be provided at all times during overnight and weekend periods.

All work shall be coordinated with Butte Silver Bow County (BSB) and other site specific municipalities and shall be performed in accordance with the Contract Documents, the Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD) as published by the U.S. Department of Transportation, the Montana Department of Transportation (MDT) Standard Specifications for Road and Bridge Construction, the approved Traffic Control Plan, and as otherwise required by the Engineer.

3. **SUBMITTALS**
 - a. **Traffic Control Plan.** The Contractor shall submit a traffic control plan for any work involving public roadways. All traffic control plans shall be submitted and accepted prior to construction and shall meet the requirements specified herein. The traffic control plan shall include the following as appropriate:
 - Itemization of signing, including: type, size, shape, color, location, and MUTCD reference.
 - Temporary pavement markings for traffic channelization (cones, barrels, barricades, etc.), as necessary.
 - Flagging, including personnel numbers and location.
 - Road closures and time(s) of road closures, if necessary.
 - Special traffic patterns (pilot cars, one-way traffic lanes, detours).
 - Signage during non-work hours.

The Traffic Control Plan will be subject to review and approval by the Montana Department of Transportation (MDT) for roads under their jurisdiction, by the appropriate county for roads under county jurisdiction, and by any other public entity having jurisdiction over other public roadways (U.S. Forest Service, city, etc.). These approvals will be in addition to those provided by the Engineer in accordance with the Submittals Section. No work shall commence until all approvals of the Traffic Control Plan have been secured.

B. MATERIALS

All traffic control devices and materials shall be in accordance with MDT Standard Specifications for Road and Bridge Construction, most current edition.

C. CONSTRUCTION REQUIREMENTS

All devices utilized for traffic control shall be in accordance with the requirements of the Manual on Uniform Traffic Control Devices (MUTCD) for Streets and Highways, most current edition. **All high visibility cones, barrels, candles, etc. used by the Contractor for traffic control shall be 42 inches in height (minimum).**

Before placement of any traffic control for any stage of construction, the Contractor shall have on hand, at the project site, all necessary traffic control devices required for that construction stage. All traffic control devices necessary for construction shall be properly placed and in operation and approved before any construction is allowed to start. All devices shall be constructed and erected in a workmanlike manner and shall be properly maintained, cleaned, and operated during the entire time they are used. They shall remain in place only as long as they are needed and shall be removed immediately thereafter. Where operations are performed in stages, there shall be in place only those signs that apply to the present stage of construction. Signs that do not apply to the existing conditions shall be covered with opaque material, turned, or removed, so as not to be readable to oncoming traffic.

Construction equipment, vehicles, materials, and debris shall be stored or parked a minimum of 30 feet from the edge of the traveled way or behind guardrails, etc., as appropriate. When it is not feasible to park equipment or store materials a minimum of 30 feet from the edge of the traveled way or behind guardrails, adequate warning devices and protective measures shall be utilized.

All traffic control devices furnished by the Contractor shall remain the property of the Contractor and shall be removed from the project site when their use is no longer required. All properly installed traffic control devices shall be replaced by the Contractor when destroyed by traffic.

The Contractor shall schedule his construction operations in a manner that will assure: 1) the safety and convenience of motorists and pedestrians, and the safety of construction workers, are adequately met at all times; and 2) the project is completed in a manner most beneficial to

the project as a whole. Traffic control shall be provided in full compliance with MUTCD during materials hauling and equipment operation or transport along public roadways.

END OF SECTION 05500

ATTACHMENT A
BUTTE HILL REVEGETATION SPECIFICATIONS

BUTTE HILL REVEGETATION SPECIFICATIONS

BUTTE HILL LIMESTONE STABILIZATION

GENERAL

Work described in this section shall consist of preparing the ground surface for limestone stabilization, hauling, placing, and spreading the limestone and fill on prepared areas in accordance with this Specification at the locations shown on the Drawings.

MATERIALS

Limestone sources will be approved by EPA. Limestone may be from any approved source and shall have a calcium carbonate equivalent content of not less than 65%. All limestone must be <1 inch in diameter and 50% (weight basis) must pass a 60 mesh (<0.25 mm) sieve.

CONSTRUCTION REQUIREMENTS

pH Testing of Subgrade

Atlantic Richfield Company shall test the subgrade soil pH of all areas to be revegetated. The frequency of testing shall not be less than one test per 40,000 square feet (approximately 200 x 200 foot grid). Limestone addition shall include areas to be revegetated where the subgrade soil has a pH of less than 5.5. Acid-base accounting (ABA) may be required by EPA under certain circumstances, such as the presence of acid-generating minerals, and the method used to determine ABA shall be as described in EPA-600/2-78-054. Documentation of this sampling effort, including a map showing sampling locations and sample results, shall be included in the final construction completion document(s) for the project.

Installation of Limestone

The surface of the subgrade in the area to be covered shall be brought to grade and finished smooth and uniform immediately prior to dumping and spreading the limestone. The limestone shall be placed prior to the placing of the cover soil. A minimum 350 tons/acre (approximately a 2 inch thick layer) of limestone shall be placed on the low pH soil. Placement of the limestone layer on a site will be based on site-specific data and approved by EPA prior to placement of limestone.

Grades on the area to be covered shall be maintained in a true and even condition. Where grades have not been established, the areas shall be graded and sloped to drain. The surface shall be left smooth in an even and properly compacted condition to prevent, insofar as practical, the formation of low places or pockets where water will stand.

BUTTE HILL COVER SOIL

GENERAL

The work of this section covers all operations required for furnishing, excavating, hauling, stockpiling, spreading, and seedbed preparation of approved cover soil.

SUBMITTALS

Cover soil submittals will be provided in the Design Report or under separate cover and approved by EPA prior to use. The following submittals shall be provided to EPA for each cover soil source:

- The intended cover soil source site location, including details on the area and depth to be excavated at the source site location.
- For each cover soil source, Atlantic Richfield Company shall be required to secure at least 3 soil samples from the source area. EPA will be notified in advance of the sampling effort and the approximate location and depth where samples will be collected.
- Each of the above 3 soil samples shall be analyzed by an approved laboratory for the following parameters: texture class and particle size; pH; saturation percent; electrical conductivity (EC) in mmhos/cm; organic matter percent; NO₃ - nitrogen; available phosphorus (P); and available potassium (K). The above parameters shall be analyzed using USDA classification and test methods as described in ASA/SSSA Monograph No. 9, Methods of Soil Analysis, Parts 1-2, most recent edition or as described in EPA approved Clark Fork River Superfund Site Investigations documents. Also, each of the above 3 soil samples shall be analyzed by an approved laboratory for the following soil metals parameters: arsenic, cadmium, copper, lead, and zinc. Cover soil placement shall not begin until test results of the soil samples are known.

MATERIALS

Cover soil sources will be approved by EPA. Cover soil thickness shall be a minimum of 18 inches, unless otherwise approved by EPA in writing. Eighteen inches is considered the minimum thickness required for long-term vegetation success. Sufficient cover soil should be applied to account for settling, sloughing, and erosion. Cover soil material shall be reasonably free of any trash, rocks, lumps of soil, stumps, and brush. Rock content (i.e., particles >2.0 mm) must constitute <45% (by volume) of the cover soil and the maximum allowable rock size is 6 inches in diameter. To the extent possible, the cover soil source should be free of any noxious weeds.

Cover soil shall be a friable material and the <2.0 mm fraction characterized as loam, sandy loam, sandy clay loam, sandy clay, clay loam, silty clay, silty clay loam, silt loam, or silt in accordance with the USDA Soil Conservation Service textural classification provided below. Per approval of EPA, loamy sand may be acceptable from 6 to 18 inches in certain circumstances.

The soil pH shall be between 5.5 and 8.5. The soil SAR shall be <12. Soil saturation percent will be less than 85% and greater than 25%. The soil shall have an EC less than 4 mmhos/cm. NO₃, P, and K will be used by EPA and Atlantic Richfield Company to verify fertilizer rates.

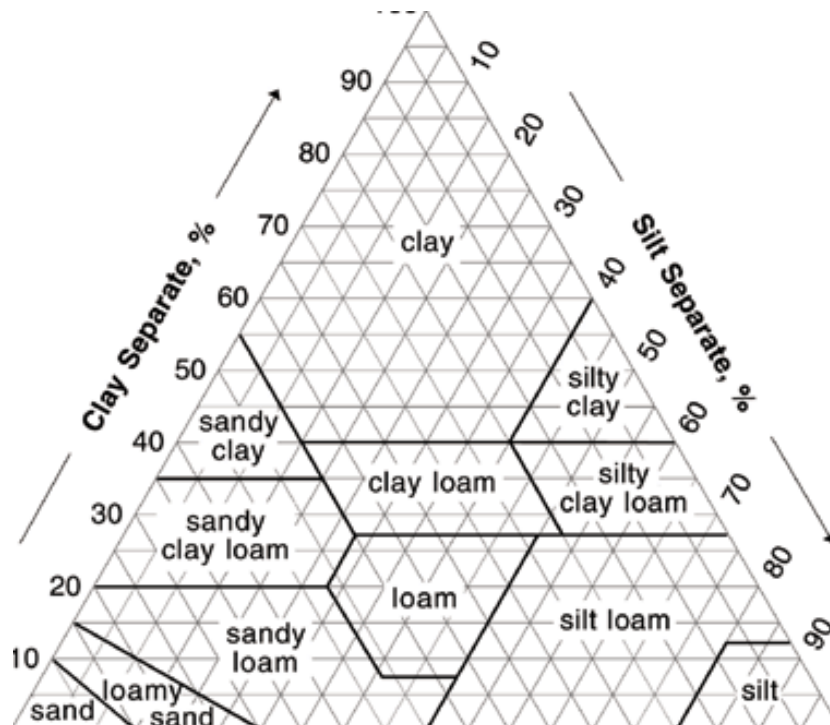


Figure 1. Graphic guide for textural classification of the less than 2 mm portion. (Source: USDA Soil Conservation Service)

The following chemical suitability criteria are general guidelines to be followed as screening standards:

As	<97 mg/kg
Cd	<4 mg/kg
Cu	<250 mg/kg
Pb	<100 mg/kg
Zn	<250 mg/kg

With the exception of zinc, these suitability criteria were established for parks, play areas, and residential yards in the Final Work Plan for Residential Areas, Butte Priority Soils Expedited Response Action prepared by AERL dated May 1, 1995. These values were provided in a February 14, 1995, letter from Sara Weinstock (EPA) to Dave Sinkbeil (AERL) providing final comments on the above work plan. The criterion for zinc was reduced to <250 mg/kg from <500 mg/kg to take into account potential phytotoxic effects noted at the higher level in the Final Baseline Ecological Risk Assessment, Anaconda Regional Water, Waste, and Soils Operable Unit, Anaconda Smelter NPL Site, Anaconda, Montana, prepared in October 1997 by CDM Federal Programs Corporation for EPA. The chemical suitability criteria listed above were established for the Butte Hill and may not be appropriate for use at other Clark Fork River Basin Superfund Sites.

It should be noted that some exceedances of the above criteria may still allow successful long-term vegetation. Therefore, if cover soil sampling shows a variance from the chemical suitability criteria, Atlantic Richfield Company will notify EPA and a plan to address the usability of that cover soil source will be discussed. EPA must approve in writing any cover soil sources which exceed the above suitability criteria.

CONSTRUCTION REQUIREMENTS

Visual inspection of excavated cover soil shall be a continuous process to carefully observe and recognize changes in source material characteristics. Visual inspection, in conjunction with hand-texturing of the <2.0 mm fraction, will be used to determine the adequacy of the borrow material ahead of excavation, to assure that current material meets textural criteria, and to identify areas to move to if material begins to fall out of specification. Each inspection shall record the location, test number for that day, date, time, estimated rock content percentage, and soil texture (<2.0 mm fraction). The frequency of inspection is dependent on the variability of the cover soil source material, but must be performed and recorded at least once daily during periods of source material excavation and transport. It is desirable to have the same person perform the inspections for the duration of excavation at a particular source area. In addition to the above visual inspections, textural analysis by laboratory hydrometer testing may be requested by EPA at a rate not to exceed one test for every 5,000 cubic yards of cover soil material excavated. These tests will be used for comparison and guidance for field testing and field observations. Copies of all inspection records and laboratory analyses shall be provided to EPA for review. Summaries of inspection records and analyses shall be included in the final construction completion documents for the project.

For revegetation purposes, slopes must not exceed a maximum of 3:1 (3 horizontal to 1 vertical)

unless previously agreed to by EPA and Atlantic Richfield Company because of site specific requirements. Cover soil shall not be placed until the areas to be covered have been properly prepared, the limestone layer appropriately applied (if required), all construction work in the area has been completed and approved by Atlantic Richfield Company, and EPA notified that all subgrade preparations have been completed.

After the cover soil has been spread, large clods, hard lumps, rocks, and large roots over 6 inches in diameter; litter; or other foreign material (exposed iron, timbers, etc.) shall be raked up, removed from the cover soil and disposed of properly. Further preparation of the cover soil for seeding is provided in the specifications for Seeding and Fertilizing.

Atlantic Richfield Company shall grade the source area borrow site(s) to existing contours at slopes not to exceed 3:1 (unless previously agreed to by EPA and Atlantic Richfield Company because of site specific requirements) and to provide positive drainage. Atlantic Richfield Company shall replace stockpiled topsoil to the borrow area. The borrow area shall be prepared for seeding, mulching, and fertilizing as are other areas receiving cover soil.

BUTTE HILL ORGANIC AMENDMENT APPLICATION

GENERAL

Organic amendment application shall consist of furnishing, applying, and incorporating soil amendments, such as manure and compost, at locations and rates designated on the Drawings.

SUBMITTALS

Organic amendment submittals will be provided in the Design Report or under separate cover and approved by EPA prior to use. The following submittals shall be provided to EPA for each organic amendment source:

- Location of Supplier;
- For each supplier, at least three organic amendment analyses, including gravimetric water content, rock and other fragment content, and organic matter content, as described further under Materials; and
- Proposed organic amendment application and incorporation methods and equipment.

MATERIALS

Analyses for organic amendments (such as manure, compost, etc.) shall include the gravimetric water content (% dry weight), the percentage of rock and/or other fragments >2.0 mm fraction (% dry weight), and organic matter content of the <2.0 mm fraction (% dry weight). The organic matter content of the <2.0 mm fraction shall be determined in the laboratory using Walkley-Black procedure, ASA, Meth. Soil Anal., 1986, Method 29-3.5.2.

If manure is used as the organic amendment source, cattle manure shall be the preferred manure type. Straw bedding material mixed into the manure is acceptable, but it shall not constitute more than 20% of the dry weight.

Application Rate

The field application rate shall be calculated using 3% organic amendment on a dry weight basis in the upper 6 inches of cover soil. Upon approval or direction from EPA, the 3% application rate may be modified to account for site-specific conditions. Analyses for organic amendments shall be submitted for each Supplier on a regular basis to determine if adjustments to the field application rates are necessary. The water and rock and/or other fragment content shall be deducted in calculating the field organic amendment application rate. Documentation of the organic amendment application, including application rate calculations, shall be included in the final construction completion documents(s) for the project.

CONSTRUCTION REQUIREMENTS

Stockpiling Organic Amendment

Prior to stockpiling organic amendment on site, the Contractor shall develop an acceptable stockpiling plan for Atlantic Richfield Company review and approval. The plan shall include the location of the stockpile and adequate measures to prevent contamination of underlying and adjacent soils and prevent air or water pollution.

Site Grading

Prior to placement of the organic amendment, all areas shall be graded as necessary to approximately restore the design contours of the ground or to produce a contour that will blend with contours of adjacent areas. This shall include grading erosion channels in revegetated areas that are to receive organic amendment.

Organic Amendment Application

Organic Amendment shall be applied with agricultural manure spreaders or other approved application equipment that enables spreading a uniformly regulated amount of material.

For a specified application rate, the Contractor shall apply the organic amendment in a uniform manner across the landscape. Localized organic amendment application thicker than 6 inches is unacceptable.

Contractor shall calibrate the organic amendment spreader prior to each use of the equipment unless site conditions have not changed and equipment settings have not been altered since previous calibration. Calibration records shall be furnished to Atlantic Richfield Company. Upon request, copies of equipment calibration shall be provided to EPA for review. All calibration records shall be included in the final construction completion document(s) for the project.

Under no circumstances shall the Contractor apply the organic amendment during wind conditions strong enough to displace material onto adjacent sites.

Organic Amendment Incorporation

Following organic amendment application, the soil shall be ripped to a 6-inch depth at 12-inch centers. The soil shall then be tilled to a depth of 6 inches with a disc, rototiller, moldboard plow, or chisel plow. An agricultural disc with a disc diameter of approximately 20 inches having cone-shaped discs at a spacing width of 6-8 inches is recommended. Multiple tilling equipment passes may be required to achieve adequate incorporation. Adequate incorporation will be a complete and uniform mixing of the manure and soil to a depth of 6 inches. All tillage procedures shall be completed as soon as practicable after amendment application.

BUTTE HILL SEEDING AND FERTILIZING

GENERAL

Revegetation work described in this section includes fertilization, seeding, and mulching on all project designated and disturbed areas upon completion of construction work. These areas include finished embankment slopes, borrow areas, areas to be revegetated, and disturbed areas.

MATERIALS

Seed

Hand collected native species and some of the special wetland species collected cannot meet the following requirements. All seed shall comply with, and be labeled in accordance with, the Montana Seed Law. Montana Code Annotated (MCA) 80-5-104 (2) states ... Indigenous seeds, as defined in 80-5-101, in amounts of one pound or more, whether in packages or bulk, must be labeled with the following information:

1. The statement “Labeled only for reclamation purposes”;
2. Lot number or other distinguishing mark;
3. The common name, genus, species, and subspecies, when applicable, including the name of each kind of seed present in excess of 5 percent. When two or more kinds of seed are named on the label, the label shall specify the percentage of each. When only one kind of seed is present in excess of 5 percent and no variety name or type designation is shown, the percentage must apply to seed of the kind named. If the name of the variety is given, the name may be associated with the name of the kind. The percentage in this case may be shown as shown as pure “live seed” and must apply only to the seed of the variety named;
4. State or county of origin;
5. The approximate percentage of viable seed, together with the date of test. When labeling mixtures, the percentage viability of each kind shall be stated;
6. The approximate percentage, by weight, of pure seed, meaning the freedom of seed from inert matter and from other seeds;
7. The approximate percentage, by weight, of sand, dirt, broken seeds, sticks, chaff, and other inert matter;
8. The approximate total percentage, by weight, of other seeds;
9. The name and approximate number of each kind of species of prohibited and restricted noxious weed seeds occurring per pound of seed; and

10. The full name and address of person, firm, or corporation selling the seed.

As listed in the Montana Seed Law, seed shall contain no “PROHIBITED” noxious weed seed. The seed shall contain no “RESTRICTED” noxious weed seed in excess of the maximum numbers per pound, as specified by MCA 80-5-105, or as specified by the appropriate BSB County Weed Board, whichever is more stringent.

As defined by MCA 80-5-101(4), indigenous seeds include the seeds of those plants that are naturally adapted to an area where the intended use is for revegetation of disturbed sites. These species include grasses, forbs, shrubs, and legumes.

The Contractor must supply Atlantic Richfield Company with all seed bag tags and certification from the supplier stating that the seed complies with the Federal Seed Act and the Montana Seed Laws (MCA 80-5-101- through 305). Upon request, copies of said tags shall be submitted to EPA for review. Copies of seed bag tags and certification shall be included in the final construction completion documentation the project.

When legumes are seeded as the predominant mixture, the seed supplier shall include inoculants (rhizobia) and provide documentation as specified in the Seed Certification. Seed Certifications shall be submitted to Atlantic Richfield Company prior to any seeding. The Contractor shall also submit a copy of the bill or other documentation from the seed supplier showing actual bulk weights of the individual seed types combined in the mix an verification of legume inoculation. The required certifications and documentation shall be provided to Atlantic Richfield Company at least three days prior to the seeding.

Fertilizer

Fertilizer shall be delivered in standard-size bags of the manufacturer showing weight analysis and manufacturer’s name, or in bulk quantities accompanied with written certifications from the manufacturer stating that the fertilizer supplied complies with applicable Specifications.

Fertilizer shall be soluble commercial carrier of available plant food element or combination thereof. The fertilizer to be used on the project shall supply the quantities of available chemical elements stipulated below. The fertilizer shall be of uniform composition and in good condition for application by suitable equipment. It shall be labeled with the manufacturer’s guaranteed analysis, as governed by applicable fertilizer laws. Any fertilizer that becomes contaminated or damaged, making it unsuitable for use, shall not be accepted. All required fertilizer certificates shall be provided to Atlantic Richfield Company a minimum of three days prior to fertilizing. The certification shall include the guaranteed analysis of the fertilizers stated in the terms of the percentages of nitrogen, and available phosphorous, potash, and boron, in that order.

Mulch

Vegetative mulch shall be either grass hay or straw. Grass hay material shall be composed primarily of perennial grasses. The grass hay mulch shall contain greater than 70 percent grass by weight and shall not contain more than 10 percent alfalfa, crested wheatgrass or yellow sweet clover. Grass hay shall be relatively free of noxious weeds and other undesirable species.

Straw mulch material shall be clean grain straw, shall be relatively free of noxious weeds and other undesirable species, and shall not contain greater than 5 percent cereal seed by weight, i.e., seed heads. Wheat straw will be used whenever possible. Harvesting will be performed with modern combines, which leave less grain in the straw. Written approval of straw and hay sources from the supervisor of the BSB County weed board shall be obtained.

Chopped or ground material is not acceptable. The mulch material is not acceptable if it is damaged by rotting, molding, etc. to seriously limit its use for mulch. It shall be relatively free of stones, dirt, roots, stumps, or other foreign material.

Application rates shall be 3,000 lbs/acre on flat non-critical erosion and potential dust generating areas and 4,000 lbs/acre on all critical runoff and potential dust generating areas. Exact application rates will be adjusted in the field to accommodate differences in mulch material and seedbed conditions.

CONSTRUCTION REQUIREMENTS

Seedbed Preparation

Prior to executing the seeding, fertilizing and mulching work items, the seed bed at all sites shall be prepared so these items can most efficiently be completed, with the areas resulting in reasonable conformity to specified line and grade. The fertilizing, seeding, and mulching work items shall be executed only after the seedbed condition has been approved by Atlantic Richfield Company. The cover soil shall be prepared as described in the Cover Soil specifications.

The seedbed surface must be in a condition that does not preclude growth at the time of application of seed. Conditions that may preclude growth include, but are not limited to: large clumps, clods, and impervious crusts of dirt; areas too tightly compacted to allow seed growth; and areas of loose soils which could possibly become too compacted during the seed applications to allow growth. The decisions on the conditions of the seedbed shall be made by Atlantic Richfield Company. If Atlantic Richfield Company determines the seedbed is inadequate for seeding, the Contractor shall treat the inadequate areas, as directed by Atlantic Richfield Company, to attain as nearly as practicable the adequate condition at no additional cost to Atlantic Richfield Company.

Excessively tight or compacted soils shall be loosened to the minimum depth of 6 inches. Disking, chiseling, or tilling of the soils shall be done at right angles to the natural flow of water on the slopes, unless otherwise directed or approved by Atlantic Richfield Company. Compaction of the soil, when required, shall be performed by equipment that shall produce a uniform rough-textured surface ready for seeding and mulching. Existing structures and facilities shall be adequately protected and any damage done by the Contractor shall be repaired or adjusted to the satisfaction of Atlantic Richfield Company.

Seed Application

General

Slopes and areas finished during the period of October 15 through June 15 may be permanently

seeded within this time period. The Contractor must obtain Atlantic Richfield Company permission to commence seeding operations. Slopes and areas finished during the period June 16 through October 14 shall receive an annual cover crop from the straw mulch seed to protect the in-place cover soils during this period. The control of noxious weeds and other undesirable species will also be addressed during this period. The perennial seed mix shall then be applied to the areas after October 15. EPA shall be notified prior to commencement of seeding activities.

Specifications of each type of seed mix are outlined below. The seeding of steep slopes, narrow medians, or small areas that are impractical to seed by drill may be performed by using the hydraulic seeding methods, when approved by Atlantic Richfield Company. The hydraulic seeding methods shall be used when the seedbed surface is too wet or swampy to permit seeding by drill. Hydraulic seeding methods shall not be used during adverse weather, as determined by Atlantic Richfield Company.

The applied seed, regardless of the method of application, shall not be covered by a soil thickness greater than 1 inch in depth.

Seed Application Equipment

Drill Seeding

Seeding equipment used for applying grass/forb seed must be designed, modified or equipped to regulate the application rate and planting depth of the seed mixture. Seed must be uniformly distributed in the drill hopper during the drilling operation. Acceptable drills are: custom seeders, furrow drills, disc drills or other drills approved by Atlantic Richfield Company. All seeding equipment shall be operated perpendicular to the slope. Contractor shall calibrate the drill seeder prior to each use of the equipment unless site conditions have not changed and equipment settings have not been altered since previous calibration. Calibration records shall be furnished to Atlantic Richfield Company. Upon request, copies of equipment calibration shall be provided to EPA for review. A summary of all calibration records shall be included in the final construction completion document(s) for the project.

Planting depth shall be regulated by depth bands or coulters. The drill box shall be partitioned by dividers no more than 24 inches apart, in order to provide for more even distribution on sloping areas. The rows or planted seed shall be a maximum of 8 inches apart. Drilling depth shall be from 1/4 to 1 inch.

Broadcast Seeding

Seeding by hand or mechanical broadcasting shall be permitted on areas inaccessible to drills or impractical to seed by other prescribed methods. The broadcast seeding rate shall not be less than twice the drill seeding rate. Following the seeding, the soil shall be hand-raked to cover the seed. Broadcast seeding requires the prior approval of Atlantic Richfield Company.

Hydraulic Seeding

The Contractor must provide one pound of wood fiber mulch per each 3 gallons water in the hydraulic seeder as a cushion against seed damage. The mulch used as a cushion may be part of

the total required mulch with the remainder applied after the seed is in place. The Contractor may be required to use extension hoses to reach the extremities of slopes.

When using vegetative mulch, the Contractor may mix the seed with the fertilizer if his hydraulic seed equipment is capable of uniformly mixing water, fertilizer, and seed, in that order, and power blowing or spraying the mixture uniformly over the seedbed. After blending, the slurry shall be applied to the seedbed within 45 minutes after the seed has been added to the water-fertilizer mixture. If the slurry cannot be applied within the specified time, it shall be fortified, at no cost to Atlantic Richfield Company, with the correct ratio of seed to the remaining slurry and a new 45-minute time frame established for applying the fortified mixture. At no time shall seed and fertilizer remain in a slurry for more than 45 minutes.

Seed Application Areas/Rates - The revegetation mixes include:

**Butte Hill 1997 Primary Seed Mixture
Revegetation Mix**

Seed Mixture	Rate, #PLS/Acre
Slender Wheatgrass	3.0
Thickspike Wheatgrass	2.0
Sheep Fescue	2.0
Crested Wheatgrass	1.0
Ladak Alfalfa	1.0
Red Clover	2.0
Canada Bluegrass	1.0
Birdsfoot Trefoil	1.0
Total	13.0

Butte Hill

Alternate Seed Mixture No. 1 - Gentle Sloped Areas (Less than 10:1) Revegetation Mix

Seed Mixture	Rate, #PLS/Acre	Planting
Bozoisky Russian Wildrye	5.0	Initial seeding, drill seeded on 15-18 inch centers.
Ladak Alfalfa	2.0	Interseeded during following years as determined by vegetation monitoring.
Total	7.0	

Butte Hill

Alternate Seed Mixture No. 2 B Grass-lined Ditches

Seed Mixture	Rate, #PLS/Acre
Smooth Broughm	5.0
Birdsfoot Trefoil	1.0
Red Clover	0.5

Pure live seed application rates shall be as specified in the tables.

The 1997 primary seed mixture was proposed by BSB County and is based upon their monitoring results for successful revegetation within the Butte area and has been reviewed and approved by BSB County, EPA and the State for use in upland areas of the Butte Priority Soils Operable Unit. The Alternate Seed Mixture No. 1 will only be used in areas with slopes of <10:1 that are particularly susceptible to weed infestation. Additional optimal conditions for use of the alternative seed mix include locations with high moisture holding capacity and shelter from strong wind conditions. The Alternate Seed Mixture No. 2 has been proposed by BSB County and is an option for hand seeding grass-lined ditches and detention basins.

Calculations of pure “live seed” may be made on the basis of either a germination test or a tetrazolium test in addition to the purity analysis. Seed shall be applied on a pure “live seed” basis. The quantity of pure “live seed” in a 100-lb. container shall be determined by the formula: 100 multiplied by germination percentage, and this product multiplied by the purity percentage. For example, if the seed is 85 percent pure and test 90 percent germination, then a 100-lb. container would contain 76.5 pounds of pure “live seed”.

Fertilizer Application

If surface soil nutrient availability data are not available, fertilizer will be applied at a rate to achieve soil concentrations of 60 lbs. of nitrogen (N) per acre, 80 lbs. of P₂O₅ per acre, and 150 lbs. of K₂O per acre. Mechanical or hydraulic methods of application are allowed, providing a uniform application at the specified rate is accomplished. The application method is subject to approval by Atlantic Richfield Company. When scheduling and soil conditions permit, the fertilizer shall be incorporated into the soil by disking, raking, or shallow plowing to the full depth of the topsoil or to a maximum depth of six inches, whichever is less.

Fertilizer shall be applied to the prepared seedbed prior to seeding or mulching and shall be blended with the top layer of soil or concurrently with the seed (as “no-till” drills allow). Upon EPA approval, fertilizer may be applied subsequent to seeding and mulching. Refertilization following seedling establishment will not require incorporation. In no instance shall subsoil be incorporated into the seedbed as a result of the fertilization operation.

Mulch Application

Mulch is usually applied during the summer and early fall and drill seeded after October 15th. The mulch shall be applied in a uniform manner by a mulch spreader at rates varying from 2,000 to 4,000 lbs. per acre. The actual rate utilized shall depend upon site conditions (i.e., slope, erosion potential, etc.) and shall be approved by Atlantic Richfield Company and EPA prior to application. The mulch spreader shall be designed specifically for this type of work. The vegetative material shall be fed in the mechanical spreader at an even, uniform rate.

The mulch shall be anchored into the seedbed by using a mulch tiller (crimper). Straw or hay shall be clean grain straw and shall be pliable.

Mulch tillers shall have round, flat, notched blades of these approximate dimensions: 0.25-inch thick by 18 inches in diameter and spaced 8 inches apart. The tiller shall have sufficient weight to force the vegetative mulch a minimum of 3 inches into the soil and shall be equipped with disc scrapers. Mulch tilling shall be done on all slopes capable of being safely traversed by a tracked vehicle. All mulch tilling shall be done perpendicular of the flow-line of the slope.

Mulch, where required, will be applied to seeded areas as close as possible to the completion of seeding operations for the area. Mulch shall not be applied in the presence of free surface water, but may be applied upon damp ground.

Mulch shall not be applied to areas having a substantial vegetative growth, such as grasses, weeds, and grains. Areas not to be mulched shall be determined by Atlantic Richfield Company. Mulching shall not be done during adverse weather conditions or when wind prevents uniform distribution. Application shall be in a manner to not seriously disturb the seedbed surface.

Appendix D

Design Report

**SILVER BOW CREEK/BUTTE AREA NPL SITE
BUTTE PRIORITY SOILS OPERABLE UNIT**

Draft Final

*Third Cycle Best Management Practice (BMP)
Scrap H Road Design Report*

Atlantic Richfield Company

August 2017

SILVER BOW CREEK/BUTTE AREA NPL SITE BUTTE PRIORITY SOILS OPERABLE UNIT

Draft Final

Third Cycle Best Management Practice (BMP) Scrap H Road Design Report

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August 2017

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LIST OF FIGURES

Figure 1. Scrap H Road Culvert Project Hydrology Plan View

LIST OF ATTACHMENTS

Attachment A Watershed Hydrograph
Attachment B Pipe Flow Analysis Results
Attachment C Rock Section Stability Results
Attachment D Storm Outfall Results

REVISION SUMMARY

Revision No.	Author	Version	Description	Date
Rev 0	Leonard J. Dueck, PE	Draft	Submitted to Atlantic Richfield Company for review	8-10-2017
Rev 1	Leonard J. Dueck, PE	Draft Final	Submitted for Agency Review	8/24/2017

1.0 SITE LOCATION AND BACKGROUND

A wooden flume (culvert) located under Scrap H Road approximately 550 feet east of its intersection with N. Main Street in Walkerville, Montana, collapsed. Scrap H Road is a public road and is used as a primary truck route into the Butte-Silver Bow (BSB) Mine Waste Repository. The current road section narrows over the collapsed wooden flume, which creates a bottleneck when truck traffic meets at the narrow section. The collapsed flume causes storm water to back up against the elevated road section. The south slope is steep and barren with multiple erosion areas where storm flows drain off of the road section. As part of this work, the road section will be widened to meet BSB gravel road specifications and moved north to flatten the existing south slope to a 3:1 horizontal:vertical grade and the north slope to a 4:1 horizontal:vertical grade. Berms will be constructed along the sides of the road to direct storm flows to an area where a riprap rock section will protect the reclaimed slopes and direct water to the new culvert inlet and outlet. The regraded slopes will be protected by a standard cap and cover consisting of 12 inches of growth media and 6 inches of top soil. The existing outfall channel will be protected by a riprap dissipater to prevent erosion during significant storm events. Construction will involve approximately 400 feet of new road construction and the associated side slopes. The new 30-inch high density polyethylene (HDPE) culvert is oversized to allow for possible future development and avoid having to excavate the reclaimed area. The storm water outfalls from this site will continue to be directed into the Alice Pit complex. Construction will provide adequate drainage, improve road safety, stabilize a steep south slope, reduce erosion, and improve aesthetics.

2.0 SITE ANALYSIS

The hydrology for the site was analyzed using Hydraflow Express Extension for AutoCAD Civil 3D, 2015. The analysis was conducted for a 25-year, 24-hour, Soil Conservation Service (SCS) Type I event, as required by the Agencies. The specific event totaled 2.6 inches of precipitation as recorded by National Oceanic and Atmospheric Administration (NOAA), listed in Atlas 2, Volume 1 (NOAA, 1973). The site was delineated into a single watershed area, which was determined by a previous site walk-through, surveying, and AutoCAD Civil 3D 2015 watershed features (see Figure 1).

3.0 HYDROLOGY

Determining the flow that the watershed would generate during a 25-year, 24-hour storm event required applying several parameters. The parameters were input into the Hydraflow software and are as follows:

- **Slope:** The slope of the watershed was determined from an aerial survey. The software required the slope be input as a percentage that was calculated by the elevation difference between the highest and lowest point of the storm water path, divided by total length of the storm water path. The resulting quotient was multiplied by 100 for representation by percentage. The elevation change, length, and slope of each watershed segment from the bottom discharge are as follows:

- Segment 1 – 323 feet; 6,323 to 6,358 feet; 10.8%.
- Segment 2 – 324 feet; 6,358 to 6,380 feet; 6.8%.
- Segment 3 – 272 feet; 6,380 to 6,407 feet; 9.9%.
- Segment 4 – 181 feet; 6,407 to 6,413 feet; 3.3%.
- Segment 5 – 94 feet; 6,413 to 6,415 feet; 2.1%.

Segments 4 and 5 were determined to be sheet flow with a Manning's n value of 0.13.

- **Area:** The software required the area to be input as acreage, which was determined from the delineated watershed:
 - Watershed – 19.1 acres.
- **Curve Number (CN):** This number is an empirical parameter used for predicting direct runoff or infiltration from storm water. For this analysis, the CNs were obtained from *Hydrology: Water Quantity and Quality Control* (Wanielista, Kersten, and Eaglin, 1997). To determine the proper CN, the SCS hydrologic soil group must be selected first (this was determined from the site walk-through). The existing soil classification is estimated to be a loam or sandy loam type texture, which lies within soil group B. Next, the surface cover type (i.e., asphalt, dirt, grass) is estimated and the CN identified from the list from the soil group and cover type. This analysis estimated three cover types including pasture (poor to fair), house (1 acre), and paved roads (Main Street). If more than one cover type is present within the watershed, the weighted average was calculated for a more accurate CN. Determining a weighted CN is reached by multiplying the listed CN by the area of the cover type. Next, the products from multiplying each CN by the area are summed and divided by the total sum of each area, giving the weighted CN for the watershed. Areas were determined using AutoCAD and survey and aerial imagery as well as site visits. The result is below:
 - Watershed 1: Estimated area for paved roads is 0.88 acres and the selected CN is 98. The house area is estimated to be 1.00 acre and the selected CN is 68, and the area of pasture is estimated to be 17.2 acres and the selected CN is 72. The weighted average was determined to be 73.3.

After defining the slope, area, and CN for the watershed, the parameters were input into the Hydraflow software to determine the Time of Concentration (TC) and flow (see Attachment A). The result is below:

- Watershed 1: TC is estimated to be 8.0 minutes with a peak flow estimated to be 6.84 cubic feet per second (cfs).

3.1 Storm Culvert Analysis

A 2.5-foot diameter corrugated HDPE storm culvert was selected to convey the storm water from the watershed. Due to the slope of the existing drainage, the proposed culvert slope is 13.12%. The culvert was analyzed with Hydraflow Express and the culvert is inlet controlled with a total depth at the inlet of 1.24 feet, well within the capacity of the culvert (Attachment B).

3.2 Rock Outfall Analysis

The rock outfall at the bottom of the culvert was analyzed with the Federal Highway Administration (FHWA) hydraulic toolbox version 4.20. The outfall is to be constructed with 1-foot minus riprap to act as a flow dissipater and mitigate erosion at the storm outfall. The designed structure is stable as shown in Attachment C.

3.3 Rock Section Analysis

The rock section at the berm cutouts was analyzed with FHWA version 4.20. The generated flows from the road section were calculated at 0.06 cfs. The analysis was run at 0.5 cfs to ensure long-term stability. The section is stable as shown in Attachment D.

4.0 REFERENCES

NOAA, 1973. National Oceanic and Atmospheric Administration Precipitation Frequency Atlas of the Western United States, Atlas 2, Volume 1, 1973.

Wanielista, Kersten, and Eaglin, 1997. Hydrology: Water Quantity and Quality Control, Second Edition. 1997.

Figures

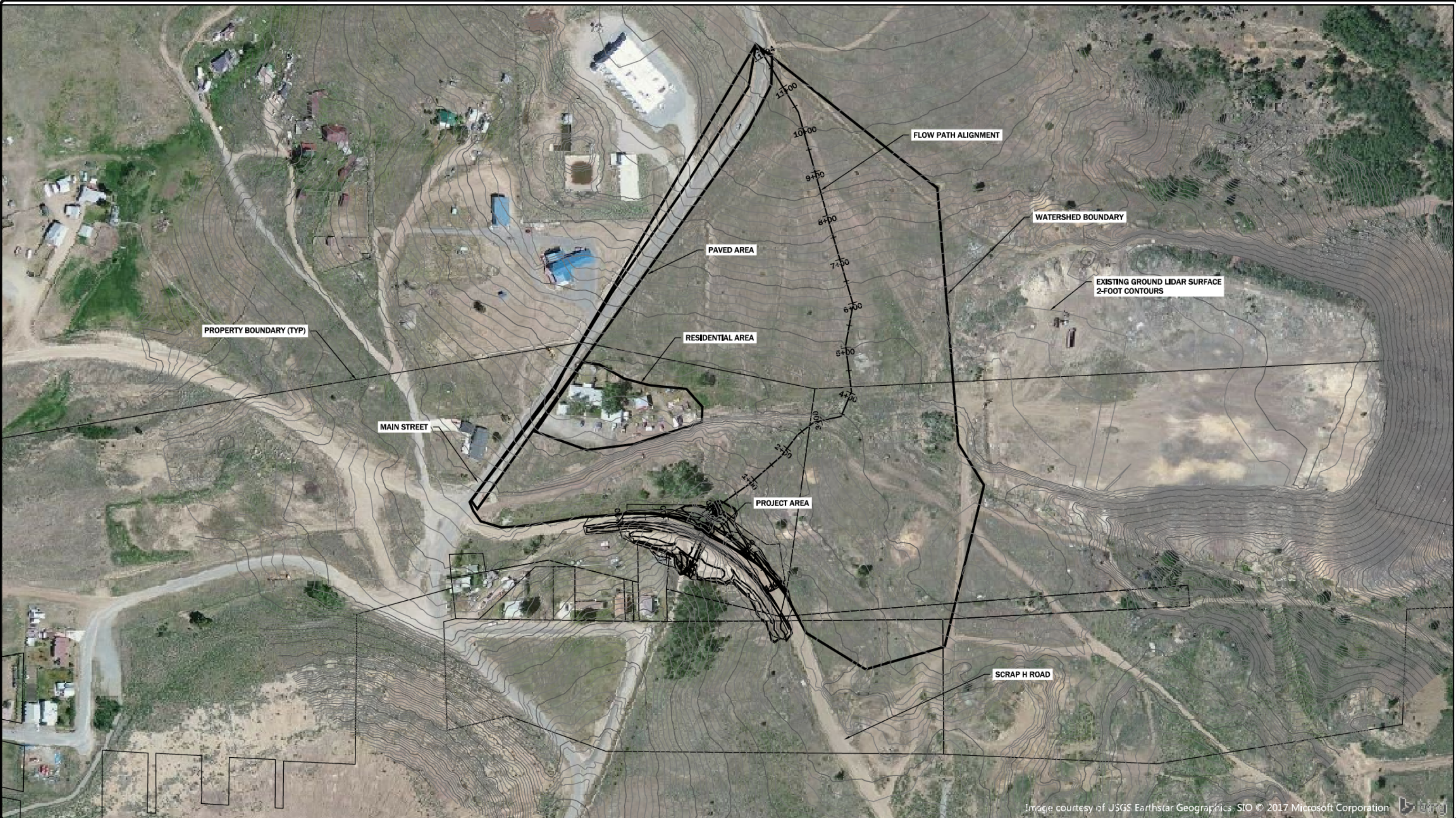


Image courtesy of USGS Earthstar Geographics. SIO © 2017 Microsoft Corporation

8/3/2017 1:08:46 PM C:\USERS\LDUECK\DESKTOP\SCRAP H ROAD\DRAWINGS\SCRAP H PT RD CULV_WATERSHED.DWG

DISPLAYED AS:
COORD SYS/ZONE:
DATUM:
UNITS:
SOURCE:

SCALE IN FEET
0 100 200

FIGURE 1

**SCRAP H ROAD
CULVERT PROJECT
HYDROLOGY
PLAN VIEW**

1101 SOUTH MONTANA
BUTTE, MONTANA 59701
(406) 782-5177

DATE: 8/17

Attachment A

Watershed Hydrograph

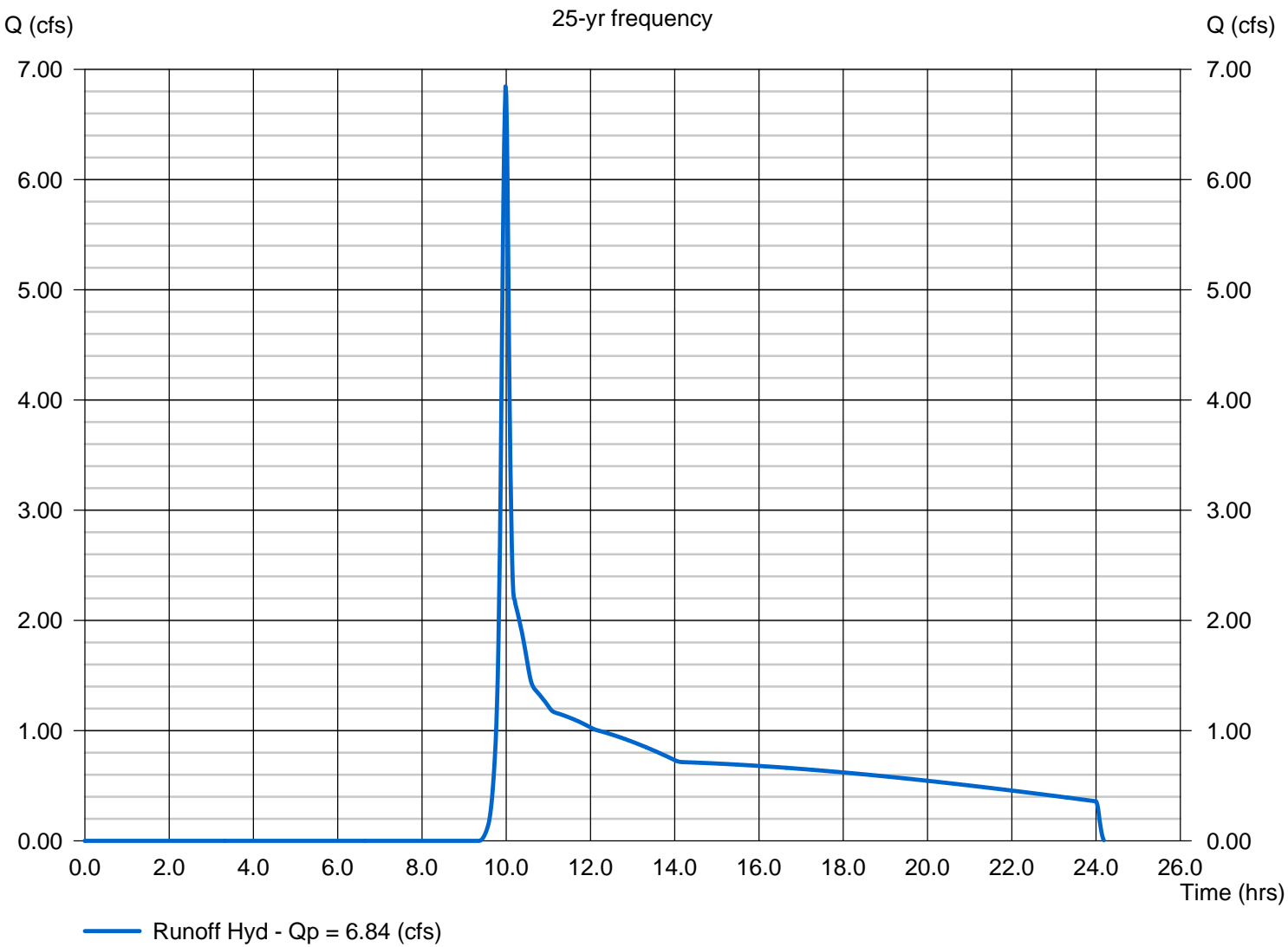
Hydrology Report

Scrap H Culvert

Hydrograph type	= SCS	Peak discharge (cfs)	= 6.844
Storm frequency (yrs)	= 25	Time interval (min)	= 1
Drainage area (ac)	= 19.100	Curve number (CN)	= 73
Basin Slope (%)	= See Worksheet	Hydraulic length (ft)	= See Worksheet
Tc method	= TR55	Time of conc. (min)	= 8
Total precip. (in)	= 2.60	Storm Distribution	= Type I
Storm duration (hrs)	= 24	Shape factor	= 484

Hydrograph Volume = 42,083 (cuft); 0.966 (acft)

Runoff Hydrograph



TR55 Tc Worksheet

Hydraflow Express by Intelisolve

SCS

Scrap H Culvert

<u>Description</u>	<u>A</u>	<u>B</u>	<u>C</u>	<u>Totals</u>			
Sheet Flow							
Manning's n-value	= 0.013	0.013	0.011				
Flow length (ft)	= 94.0	181.0	0.0				
Two-year 24-hr precip. ((in))	= 1.60	1.60	0.00				
Land slope (%)	= 2.10	3.30	0.00				
Travel Time (min)	= 1.83	+	2.58	+	0.00	=	4.40
Shallow Concentrated Flow							
Flow length (ft)	= 272.00	324.00	323.00				
Watercourse slope (%)	= 9.90	6.80	10.80				
Surface description	= Unpaved	Unpaved	Unpaved				
Average velocity (ft/s)	= 5.08	4.21	5.30				
Travel Time (min)	= 0.89	+	1.28	+	1.02	=	3.19
Channel Flow							
X sectional flow area ((sqft))	= 0.00	0.00	0.00				
Wetted perimeter ((ft))	= 0.00	0.00	0.00				
Channel slope (%)	= 0.00	0.00	0.00				
Manning's n-value	= 0.015	0.015	0.015				
Velocity (ft/s)	= 0.00	0.00	0.00				
Flow length (ft)	= 0.0	0.0	0.0				
Travel Time (min)	= 0	+	0	+	0	=	0.00
Total Travel Time, Tc					8.00 min		

Attachment B

Pipe Flow Analysis Results

Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc.

Thursday, Aug 3 2017

Scrap H Hydrology

Invert Elev Dn (ft) = 10.00
Pipe Length (ft) = 140.00
Slope (%) = 10.00
Invert Elev Up (ft) = 24.00
Rise (in) = 30.0
Shape = Circular
Span (in) = 30.0
No. Barrels = 1
n-Value = 0.012
Culvert Type = Circular Culvert
Culvert Entrance = Smooth tapered inlet throat
Coeff. K,M,c,Y,k = 0.534, 0.555, 0.0196, 0.9, 0.2

Embankment

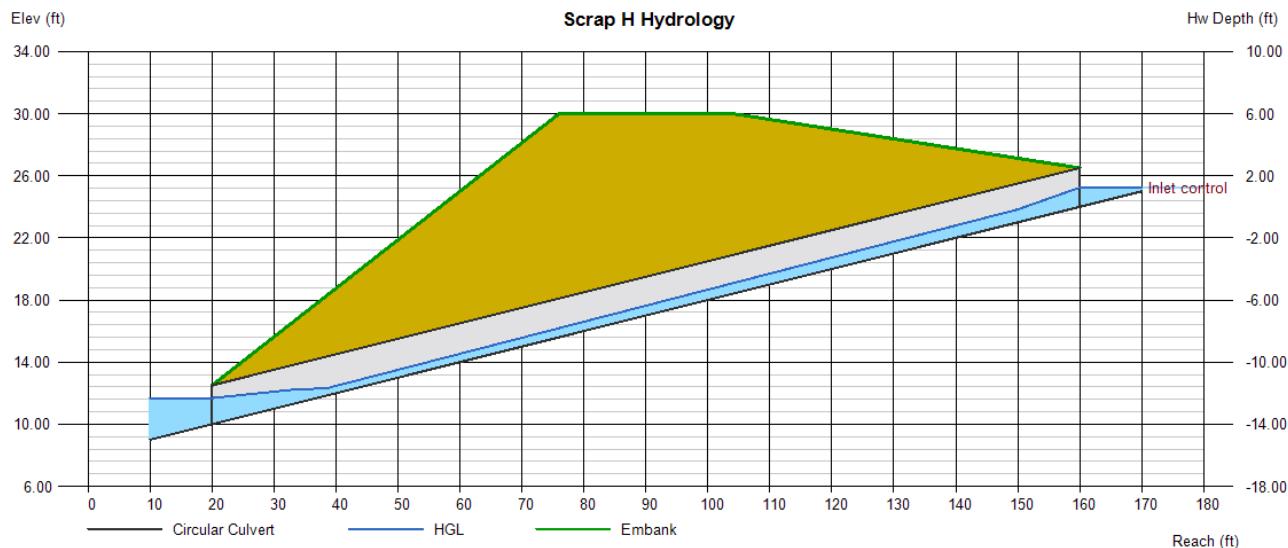
Top Elevation (ft) = 30.00
Top Width (ft) = 28.00
Crest Width (ft) = 0.00

Calculations

Qmin (cfs) = 0.00
Qmax (cfs) = 6.81
Tailwater Elev (ft) = $(dc+D)/2$

Highlighted

Qtotal (cfs) = 6.80
Qpipe (cfs) = 6.80
Qovertop (cfs) = 0.00
Veloc Dn (ft/s) = 1.94
Veloc Up (ft/s) = 4.52
HGL Dn (ft) = 11.68
HGL Up (ft) = 24.86
Hw Elev (ft) = 25.24
Hw/D (ft) = 0.50
Flow Regime = Inlet Control



Attachment C
Rock Section Stability Results

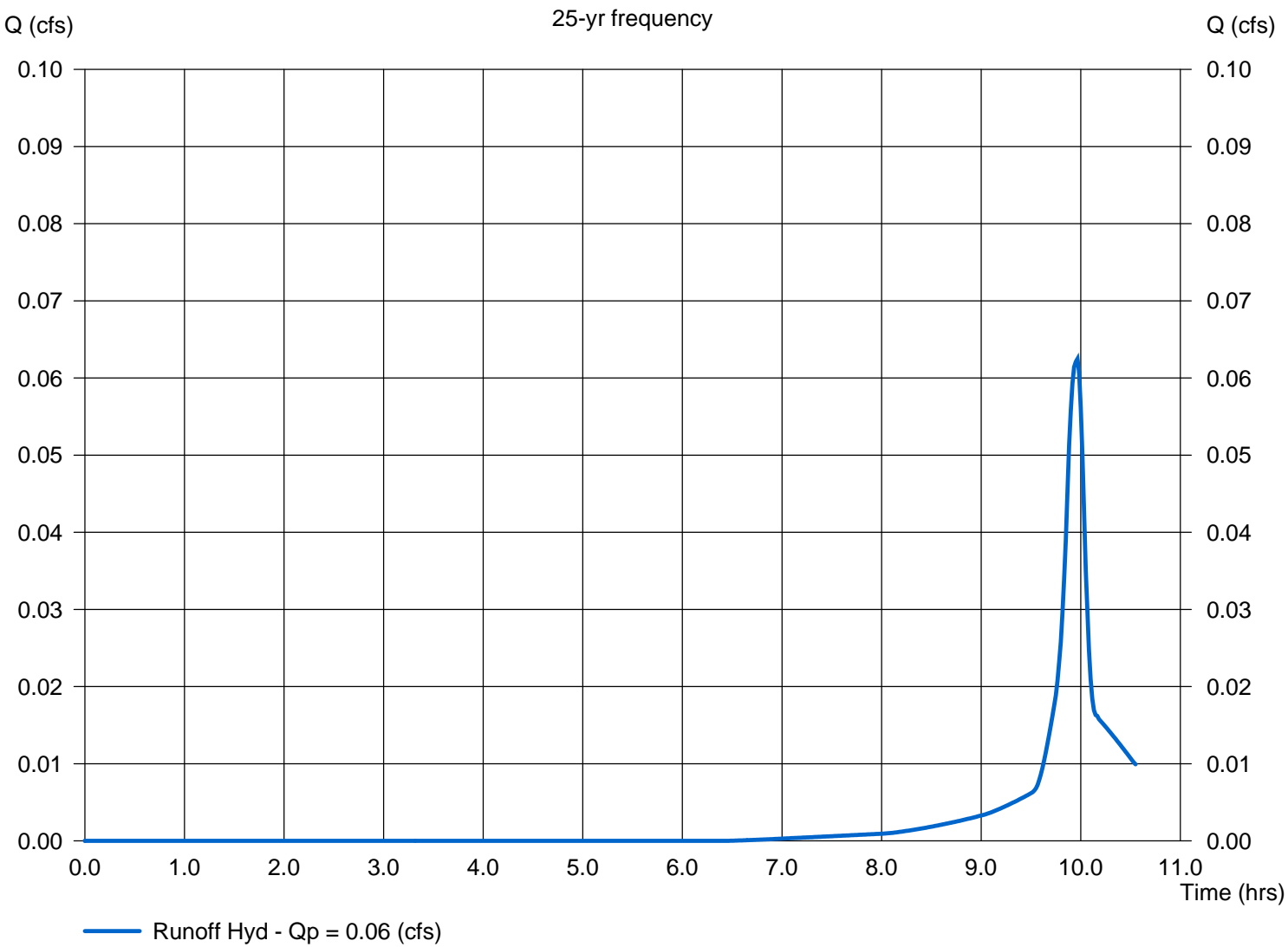
Hydrology Report

Scrap H Road Section

Hydrograph type	=	SCS	Peak discharge (cfs)	=	0.062
Storm frequency (yrs)	=	25	Time interval (min)	=	1
Drainage area (ac)	=	0.060	Curve number (CN)	=	85
Basin Slope (%)	=	See Worksheet	Hydraulic length (ft)	=	See Worksheet
Tc method	=	TR55	Time of conc. (min)	=	5
Total precip. (in)	=	2.60	Storm Distribution	=	Type I
Storm duration (hrs)	=	24	Shape factor	=	484

Hydrograph Volume = 283 (cuft); 0.006 (acft)

Runoff Hydrograph



TR55 Tc Worksheet

Hydraflow Express by Intelisolve

SCS

Scrap H Road Section

<u>Description</u>	<u>A</u>	<u>B</u>	<u>C</u>	<u>Totals</u>			
Sheet Flow							
Manning's n-value	= 0.013	0.013	0.011				
Flow length (ft)	= 135.0	74.0	0.0				
Two-year 24-hr precip. ((in))	= 1.60	1.60	0.00				
Land slope (%)	= 1.80	0.82	0.00				
Travel Time (min)	= 2.60	+	2.20	+	0.00	=	4.80
Shallow Concentrated Flow							
Flow length (ft)	= 0.00	0.00	0.00				
Watercourse slope (%)	= 0.00	0.00	0.00				
Surface description	= Paved	Paved	Paved				
Average velocity (ft/s)	= 0.00	0.00	0.00				
Travel Time (min)	= 0.00	+	0.00	+	0.00	=	0.00
Channel Flow							
X sectional flow area ((sqft))	= 0.00	0.00	0.00				
Wetted perimeter ((ft))	= 0.00	0.00	0.00				
Channel slope (%)	= 0.00	0.00	0.00				
Manning's n-value	= 0.015	0.015	0.015				
Velocity (ft/s)	= 0.00	0.00	0.00				
Flow length (ft)	= 0.0	0.0	0.0				
Travel Time (min)	= 0	+	0	+	0	=	0.00
Total Travel Time, Tc					5.00 min		

Rock Section Hydraulic Analysis Report

Project Data

Project Title: Scrap H Road 12-inch riprap

Designer: Pioneer Technical Services Inc. (MB)

Project Date: Thursday, August 10, 2017

Project Units: U.S. Customary Units

Notes: Assumed 0.5 cfs (228 gpm)

Channel Lining Analysis: Scrap H Rock Section

Notes:

Lining Input Parameters

Channel Lining Type: Riprap, Cobble, or Gravel

D50: 0.5 ft

Riprap Specific Weight: 165 lb/ft³

Water Specific Weight: 62.4 lb/ft³

Riprap Shape is Angular

Safety Factor: 1

Calculated Safety Factor: 1.00016

Lining Results

Angle of Repose: 41.15 degrees

Relative Flow Depth: 0.0335016 ft

Manning's n method: Bathurst

Manning's n: 0.000537894

Channel Bottom Shear Results

V*: 0.443107

Reynold's Number: 18204.9

Shield's Parameter: 0.047

shear stress on channel bottom: 0.380492 lb/ft²

Permissible shear stress for channel bottom: 1.60957 lb/ft²

Channel bottom is stable

Stable D50: 0.118215 ft

Channel Side Shear Results

K1: 0.802

K2: 1

Kb: 0

shear stress on side of channel: 0.380492 lb/ft²

Permissible shear stress for side of channel: 1.60957 lb/ft²

Stable Side D50: 0.0948083 lb/ft²

Side of channel is stable

Channel Lining Stability Results

The channel is stable

Channel Summary

Name of Selected Channel: Scrap H Rock Section 12" Riprap

Attachment D

Storm Outfall Results

Hydraulic Analysis Report

Project Data

Project Title: Scrap H Road Storm Outfall

Designer: Pioneer Technical Services, Inc. MB, Check LD

Project Date: Thursday, August 10, 2017

Project Units: U.S. Customary Units

Notes: Assumed 7cfs, 12-riprap at 12% slope

Channel Lining Analysis: Scrap H Channel Analysis

Notes:

Lining Input Parameters

Channel Lining Type: Riprap, Cobble, or Gravel

D50: 0.5 ft (12-inch riprap)

Riprap Specific Weight: 165 lb/ft³

Water Specific Weight: 62.4 lb/ft³

Riprap Shape is Angular

Safety Factor: 1

Calculated Safety Factor: 1.00867

Lining Results

Angle of Repose: 41.15 degrees

Relative Flow Depth: 0.498519 ft

Manning's n method: Bathurst

Manning's n: 0.0552271

Channel Bottom Shear Results

V*: 1.03989

Reynold's Number: 42723.4

Shield's Parameter: 0.0487532

shear stress on channel bottom: 2.09557 lb/ft²

Permissible shear stress for channel bottom: 2.22731 lb/ft²

Channel bottom is stable

Stable D50: 0.474503 ft

Channel Side Shear Results

K1: 0.868

K2: 1

Kb: 0

shear stress on side of channel: 2.09557 lb/ft²

Permissible shear stress for side of channel: 2.22731 lb/ft²

Stable Side D50: 0.411868 lb/ft²

Side of channel is stable

Channel Lining Stability Results

Overall the channel is stable

Channel Summary

Name of Selected Channel: Scrap H Channel Inputs